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August 1988

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Software Designer/CEO
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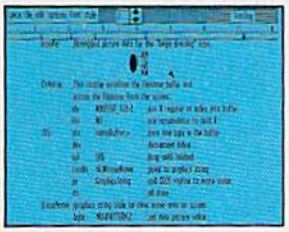

geoWrite

geoAssembler

geoLinker

geoDebugger

geoAssembler
- 23 assembler directives
- user-definable macros with up to 6 arguments
- condition assembly (.IF, .ELSE, .ENDIF, etc.)
- global and local labels
- expression evaluator recognizes 25 arithmetic and logical operators
- automatically reads bitmaps from geoWrite
- exclusive pass 1 optimization flag
- can include other source files (eg. constant definitions, etc.)
- expressions can contain external references (resolved by linker)
- symbols may contain up to 20 characters

geoLinker
- creates both GEOS and standard Commodore applications
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- resolves external references containing complex expressions
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- up to 29,000 symbols in VLIR applications (3,200 in resident module plus 1,400 per overlay module)

geoDebugger
- 70 debugger commands, including memory examination and modification, single-step, full-speed execution, disk block examine/modify, breakpoint manipulation and more
- independent debugger status window
- full symbolic disassembly
- extensive command macro language
- up to 8 independent breakpoints
- numeric entry and display in decimal, hexadecimal, binary and symbolic format
- allows debugging of non-GEOS applications
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There's so much you get with geoProgrammer—and so much you can do with it—that we couldn't list it all here. But we could put it all on one disk. Which is why so many serious hackers ask for geoProgrammer by name.

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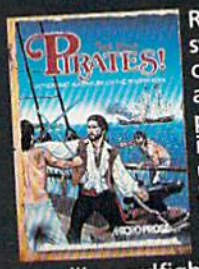

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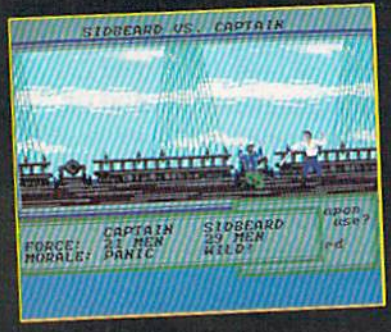

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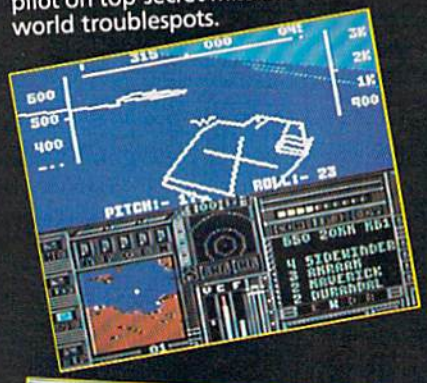

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Cover art by Rhett Anderson

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editor's notes

It's been a busy few months for Max Toy.

Appointed president and chief operating officer of Commodore Business Machines last October, Toy was charged by Commodore Chairman Irving Gould with leading "the company toward our goal of recapturing our market share in the United States."

That's no small task. From its heyday in the early eighties, Commodore fell upon hard times and loss of domestic direction. The company walked away from its success in the education market, and likewise seemed uncertain of the proper way of marketing its 64 and 128 family. For a while things were in such disarray that industry pundits frequently prepared obituaries for the 64 and for Commodore itself.

Those obituaries were premature. Once again, Commodore is profitable, knows where it is going, and knows that the 64 and 128 will play a large part in the journey. Max Toy, firmly at the helm of the company, has no doubts about the directions he will pursue. In a recent interview with COMPUTE!, he held forth on a variety of subjects, including the rumors of the 64/128's imminent demise.

"The 64 and 128 still welcome more first-time users to computers than any other product or company in the world," Toy said. "That's a tremendous opportunity. We've got an installed base for the 64 alone of many millions.

"The software community is continuing to write new and better software for the 64. And as long as the software community continues to develop and invest in new software, and as long as there are new users coming into the marketplace, this warhorse still has a significant opportunity, and one that's continuing."

When asked whether whispers of a price drop to $99 for the 64 were accurate, Toy was emphatic: "Absolutely not."

Part of Commodore's marketing difficulty may have stemmed from the widespread misperception of the 64 and 128 as game machines. Lately, of course, game machines such as Nintendo have gobbled a large share of the home entertainment market. As its Amiga and PC-compatible lines gain strength, will Commodore at last shift the 64 toward purely game-oriented marketing?

Toy says *no*. "We are a computer company first, and we bring computers to the first-time user. One of the attributes of that is the capability to play some of the finest, best-developed games, and the largest selection of games that exists in the world today—and that is on the 64 base.

"The entertainment category for the 64 is still exponentially greater—whether quantitatively or qualitatively—than anything that exists in the market today.

"But it is a *computer*, first and foremost," he emphasized. "It is still the easiest, best tool to learn programming on of any computer in the market. But it has the plus of being able to have the best entertainment out there. We will continue to position the 64 and 128 as computers first, as an entertainment system second."

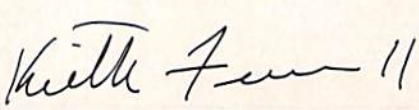
But what about Nintendo? "There are people who will be buying game machines to play games. There are people who will be buying computers that can play games, and grow their kids' skill sets and get them better prepared for the future.

"There's nothing wrong with games. But where the leverage comes from, where the *learning* comes from, is when you take that same tool, teach from it, and learn some skills that you're going to be able to use throughout the rest of your life."

Just a few months into his tenure at Commodore, the former IBM and Compaq executive is exuberant but honest about the challenges and opportunities facing the company. There is a lot of day-by-day work to be done to restore Commodore to the levels of success it once enjoyed, but not only is Max Toy ready to take on the challenge; he's also eager to face the future.

That future should see renewed success for Commodore, the *computer* company.

[The complete interview with Max Toy can be read in the August COMPUTE!.]



Keith Ferrell
Features Editor

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FOR COMMODORE PERSONAL COMPUTER USERS

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letters to the editor

There's More for Your Life at Sears

Your June feature on Commodore-ready printers failed to mention the excellent Sears SR 2000 printer. This dual-interface, dot-matrix printer works in Commodore and Epson modes, has a full range of features—such as underline, italics, sub- and superscript, tractor and friction feed, and condensed or expanded print—and it costs less than $200.

Michael D. Smith
Portland, OR

Thanks for the information. We were unaware of this printer until your letter arrived. We talked to a Sears representative who verified this and added that the SR 2000 is available for $199.99 and is compatible with every major brand of computer. In draft mode, it prints at 130 cps, and in NLQ mode, at 30 cps. A printer cable for the 64 and 128D is also available for $4.99.

Thanks All Around

In the April issue, we printed a letter from Joseph Hobart asking for donations of VIC-20s with accessories for use by students of the Apache, Hopi, and Navajo Indian reservations in northern Arizona. Here's an update from Mr. Hobart.

Thank you for printing my request for VIC-20s, for sending along the five VICs, and for your endorsement of my project. The response has been excellent. We have received computers and accessories from all over the country.

I was extremely impressed with the generosity shown. Several systems arrived with computer, cassette, and $500 to $1,500 worth of cartridges, programs, books, and other accessories! You have some very dedicated and serious computer users reading the *GAZETTE*. As of today, we have received:

40	VIC-20s with power supplies
38	Datassettes
4	printers and plotters
31	RF modulators
23	RF switch boxes
112	books (not including manuals)
156	program cartridges
711	programs on cassette
20	introductions to BASIC
343	blank cassette tapes
12	expansion boards
33	expansion memory cartridges
8	joysticks and paddles
13	floppy disks with PD software
2	modems
1	printer interface

We're a little short of RF modulators and switch boxes—not surprising since many who sent equipment were probably using monitors. We've received a number of 64 programs, but so far have only one promise of a 64 and disk drive. All of the equipment is now in place and in use. Thank you again.

Joseph Hobart
975 Mesa Trail
Flagstaff, AZ 86001

And our thanks to all the readers who responded so generously. Since this project is an ongoing program, we'd like to encourage further donations. In case you missed our April issue and would like to contribute to a worthy effort, send your donations to Joseph Hobart at the address above.

No Reply

I am not satisfied with the fact that in the past two years I've written two or three letters requesting advice on problems with the 64 which have not been published. I would like some feedback about your policy on answering letters.

J. R. Corts
Oakdale, MN

Readers would probably be amazed at the volume of mail we receive regularly. In fact, if we responded to every letter we receive, we wouldn't have the time to publish the magazine. (We do, however, read every letter.) If we see a number of questions on the same topic, we address that topic in "Feedback" or schedule an article or program on the subject. Logic tells us that if we answer a question or handle a problem for 25 different readers, we're doing better than answering one sent in by 2 readers. It's impossible to answer everyone, so our attitude is to address as many readers as we can in the time frame and space allotted by each monthly issue.

More Than a Game Machine

There's been an increasing interest in game machines such as the Nintendo and Sega. Commodore has been trying to attack these by selling the 64 as a game machine. I think more emphasis should be put on the 64 as a productivity machine. I understand that many people play games on their 64s and so do I, but I think the 64 should not be lowered into the game-machine market.

Mark Abbott
London, KY

We agree. The 64 is a great game machine, but it's also much more. When you use a Nintendo or Sega, you play games. When you use a 64, you can play a game, write a letter, create colorful and detailed art, write and design a newsletter, teach math or spelling, process data, write a program, create and play music, manage a small business, and much more.

Back Issues

I'd like you to republish "TurboTape." I still own a cassette and find it quite boring to wait for loading.

Louis Stice
Newcastle, CA

Sorry, but it's hard for us to justify republishing nearly six pages of documentation and code for a tape utility when more than 95 percent of our readers use disk drives. However, you can order the July 1985 issue, which featured "TurboTape," by sending $5 to Gazette Back Issues, P.O. Box 5188, Greensboro, NC 27403. A back-issue order blank is now published regularly in each issue.

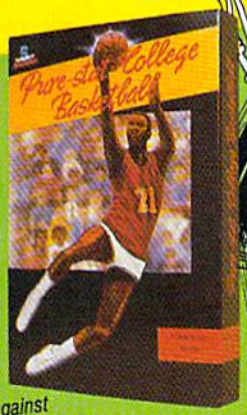
Plus/4 Support

You are the only magazine that supports the Commodore Plus/4. I would like to thank you and say it's greatly appreciated.

James K. Medeiros
Newport, RI

We're aware that there are but a few Plus/4s out there compared to the number of 64s and 128s, but we decided a few years back that with just a little extra effort we could make a number of our programs compatible with the Plus/4. In fact, a number of them run as is on the Plus/4. We receive a fair number of letters from Plus/4 users, so we know that while the number of users may be small, they're a dedicated group. Also, we're able to offer support of the Plus/4 without sacrificing the space used for 64 and 128 coverage.

Pure-stat College Basketball



Authorities say that coaching ability makes the difference in college basketball: Can you coach a team to the final 4, or even the National Tournament? Now you can find out! From the authors of PURE-STAT BASEBALL comes PURE-STAT COLLEGE BASKETBALL.

This statistically based program contains 20 great college teams from the past and present. See all the plays animated on the screen with 5 on 5 full court action. Everything from a slam dunk to a fast break. Special features include: Man-to-Man or Zone defenses, the option to SLOW-DOWN the tempo of the game (allowing a weaker team to be competitive with a stronger one), or take a 3 point shot with current teams, fatigue factors are included for each player based on time played.

In PURE-STAT COLLEGE BASKETBALL you can play against an opponent, play against the computer, or let the computer play itself (great for tournament play). This program also includes a stat compiler which saves the results of the games played. This feature allows you to scout the opposition or evaluate your own team. If you feel you're up to the challenge, set up your own tournament and test your coaching skills. Will your team make it to the final 4?

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Disks will be shipped the first week of August. Please allow 4-6 weeks for delivery.

Do you have a question or a problem? Have you discovered something that could help other Commodore users? We want to hear from you. Write to Gazette Feedback, COMPUTE!'s Gazette, P.O. Box 5406, Greensboro, NC 27403. We regret that, due to the volume of mail received, we cannot respond individually to programming questions.

Plugging In Peripherals

Is there any harm in keeping your peripherals plugged into your computer all the time, or should you plug them in as you need them?

John Potter
New Lexington, OH

You may safely leave your peripherals plugged into your computer at all times. In fact, you're likely to save wear and tear on the connectors if you do so. And remember—you should never plug in or unplug a peripheral while the power is on.

A Big Blue 64?

Recently I received a flyer advertising a program that would permit you to run IBM programs on the Commodore 64 and also run 64 programs on the IBM. I misplaced the flyer and both my wife and I have been looking for it.

Can you help? Do you know of this program and, if so, do you know where it can be purchased? I doubt that there would be any reports about it, good or bad, since it is a new product.

Vincent J. Shroad, Jr.
Morrisville, PA

We answered a similar question in the April 1988 issue of our sister magazine, COMPUTE!. The bottom line of the answer was that there's just no such thing.

In fact, it's painful to imagine a Commodore 64 emulating an IBM PC. For one thing, most PC's have at least 512K of memory, while the 64 has only 64K. You could emulate the extra memory and a hard drive with a huge stack of floppy disks, but this would slow down the program to an unbearable crawl—imagine a spelling checker that takes three months to check a document.

It's equally painful to imagine an IBM PC emulating a 64. The PC does not have sprites. It has only four colors in graphics mode. It has poor sound. So forget about playing your favorite 64 games on an IBM PC.

There are a number of available programs—public domain and commercial—that allow text files created on PCs to be read by 64s or 128s, and vice versa. In fact, the February issue of COMPUTE! *includes "The 128/MS-DOS Connection," a machine language program which allows you to read and write to disk in 128 or MS-DOS format.*

End of the Line

I own a Commodore 128 with a 1571 disk drive and a 1670 modem. My friend has an IBM clone. When we communicate via modem, we are able to "talk" to each other quite satisfactorily. However, when I attempt to send him a text file, he receives it without linefeeds, and the text overwrites itself on the same line. If he sends me a text file, I receive it in good shape. We both use Xmodem protocol.

The documentation for the terminal program tells me that Commodore computers automatically print a linefeed with each carriage return. When I examine the text file in the monitor, I expect to see each $0D (carriage return) followed by an $0A (linefeed). Such, however, is not the case.

The only solution I have found for this problem is to retype the text file, pressing the LINEFEED key at the end of each line before pressing RETURN, which results in an inordinate amount of typing.

John Breckenridge
Orange, CA

Printing a carriage return (CR) to a Commodore screen does two things: It advances the cursor to the beginning of the line (the carriage return part) and it also advances the cursor to the next line (the linefeed part). When a Commodore printer receives a CHR$(13)—the ASCII value of CR—it feeds the paper up by one line and returns the printer's carriage to the start of the line.

Thus, to Commodore computers, a single CHR$(13) marks the end of one line and the beginning of the next. Your friend's IBM clone obviously wants both a CHR$(13) and a CHR$(10) at the end of each line. There are several solutions to this problem.

Some terminal programs offer the option to automatically add linefeeds (check your documentation for details). Whenever they find a CR in the original file, they automatically append a linefeed (LF) character. In most cases, you'll have to transfer the file as text, however, instead of uploading it. Uploading via Xmodem protocol almost always sends files exactly as they exist on disk. You might be able to transfer the file from disk or you might have to load it into a buffer (a section of memory) and then transfer the buffer.

Some terminal programs allow you to load a text file into a buffer and then edit it, in which case you might be able to use a search-and-replace command to add linefeeds.

When you create the text file with a word processor, you could add linefeeds, using search-and-replace to change CRs to CR + LF. Some word processors interpret CTRL-M as CR and CTRL-J as LF.

A final possibility is to write a short BASIC program that adds LFs to a text file. Try this:

```
10 OPEN 1,8,2,"ORIGINAL,S,R":R
   EM READ FILE
20 OPEN 2,8,3,"NEWLF,S,W":REM
   {SPACE}WRITE FILE
30 GET#1,A$:S=ST
40 PRINT#2,A$;:IF A$=CHR$(13)
   {SPACE}THEN PRINT#2,CHR$(10
   );
50 IF S=0 THEN 30
60 PRINT#2:CLOSE2:CLOSE1
```

Substitute the original name of the file in line 10 and the new filename in line 20.

A Noisy Cursor

I am interested in programming the SID chip on my Commodore 64. I have two different problems. The first concerns using different waveforms and ADSR (Attack/Decay/Sustain/Release) envelopes. When I set the attack/decay to 255 (240 for longest attack, 15 for longest decay), the sustain/release to 255, and the waveform to 33, I get a sound similar to a saturated guitar. When I try different values for waveform, attack/decay, and sustain/release, the computer is silent. What causes this?

My second question concerns an interesting routine I wrote in machine language. My goal was to make a sound

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```
;Noisy cursor
;First, redirect IRQ vector to SOUND
            SEI             ;disable IRQ interrupts
            LDA  #<SOUND    ;store SOUND address in vector
            STA  788
            LDA  #>SOUND
            STA  789
;Set SID registers
            LDA  #0         ;set attack/decay to 0
            STA  54277      ;on voice 1 and
            STA  54284      ;on voice 2
            LDA  #240       ;set sustain to 15
            STA  54278      ;release to 0 on first
            STA  54285      ;two voices
            CLI             ;reenable IRQ interrupts
            RTS             ;and return
;
SOUND       LDA  646        ;use text color for volume
            STA  54296
;Use cursor position for frequencies
            SEC             ;set carry to read cursor location
            JSR  65520      ;execute PLOT
            TXA
            LSR             ;adjust slightly
            STA  54273      ;use .X for high byte in voice 1
            TYA
            LSR
            STA  54280      ;and .Y for high byte in voice 2
            LDA  #16        ;select triangle waveform and ungate
            STA  54276      ;voice 1 and
            STA  54283      ;voice 2
            LDA  #17        ;gate sound
            STA  54276      ;on voice 1
            STA  54283      ;and voice 2
            JMP  59953      ;execute normal IRQ interrupts
```

that rose and fell with cursor movement. Can you show me how to do this?

Bulfon Gabriele
Italy

There are a couple of common mistakes that cause silent SID chips. These have to do with a failure to properly set one or more of the chip's registers. Rarely is the chip itself defective.

The SID chip has three voices (1–3). You must set the registers that pertain to the particular voice or voices you want to hear. To create a sound, set the volume, location 54296; the ADSR envelope, SV+5 and SV+6 where SV=54272+7(voice number−1); the frequency, SV+1 (the high frequency) and SV (the low frequency); and the waveform, SV+4. Remember to set the frequency and the ADSR envelope before* gating *the waveform. Gating starts the attack/decay/sustain cycle and is accomplished by storing a 1 in bit 0 of the appropriate voice control register. Once the waveform has started, ungate it (start the release cycle) by storing a 0 to this bit. During this process, if you happen to store a 0 in the voice control register (clearing all eight bits) rather than store to the gate bit alone, the sound will stop entirely. This will also occur if the volume or frequency registers are set to 0.*

If you choose a pulse waveform (by setting bit 6 of SV+4), you must also POKE locations SV+2 and SV+3 with the pulse width. This must be done for each of the three voices you're using.

With regard to your second question, the machine language routine above creates a noise-making cursor.

The first part of this program points the IRQ interrupt vector at location 788 to itself so that the routine labeled SOUND will be called once every 1/60 second. It also sets the SID chip registers for Voice 1 and 2.

Each time SOUND is called, the volume for the SID chip is taken from the text color in location 646. The Kernal routine PLOT returns the current cursor position, with .X containing the row number, and .Y, the column number. These values, with slight modification, are stored in the frequency registers (high byte only) for the two voices, and a triangular waveform is initiated. Pushing the cursor down the screen thus increases the pitch of Voice 1, and moving it to the right results in a higher frequency for Voice 2.

Notice we ungate the waveform here prior to gating it. Ordinarily, you would gate the chip first, follow it with a delay so the attack/decay/sustain cycle could finish, and then ungate it to start the release cycle. In this case, we reverse the gating/ungating sequence and let the interrupt itself serve as the delay.

If you aren't that comfortable with machine language, here's the above routine in the form of a BASIC loader:

```
10 FORI=49152TO49219:READA:POK
   EI,A:X=X+A:NEXT
20 IFX<>7812THENPRINT"DATA ERR
   OR.":STOP
30 DATA 120,169,29,141,20,3
40 DATA 169,192,141,21,3,169
50 DATA 0,141,5,212,141,12
60 DATA 212,169,240,141,6,212
70 DATA 141,13,212,88,96,173
80 DATA 134,2,141,24,212,56
90 DATA 32,240,255,138,74,141
100 DATA 1,212,152,74,141,8
110 DATA 212,169,16,141,4,212
120 DATA 141,11,212,169,17,141
130 DATA 4,212,141,11,212,76
140 DATA 49,234
```

Simply load and run the program to POKE the code into memory and then type SYS 49152 to activate it.

If the noisy cursor begins to annoy you after using it for a while, you can silence it by pressing RUN/STOP–RESTORE. To restart it, type SYS 49152 again.

128 DOS Shell

How can I transfer the 128 DOS Shell which comes on the Commodore 1571 Test/Demo Disk to my own disks so that it's available when I need it?

C. E. Spurlock
Millersburg, MI

Your question—and our answer—come at just the right time. This month's Power BASIC, "128 Shell Booter" by David Ockrassa, provides a solution to your problem.

Switching Out ROM

I have a programming problem on my 64 that I'd really appreciate some help with. I am unable to switch out BASIC ROM (40960–49151) to access the RAM underneath. POKE 1,PEEK(1) AND 254 doesn't seem to work. After this POKE, location 1 remains unchanged and BASIC is unaffected. (I did not copy ROM to RAM first.) On the other hand, POKE 1,PEEK(1) AND 253 seems to work. (It hangs up the system, so it must be switching out the Kernal ROM.) I have version 3 of the Kernal.

Is there something wrong with my computer or am I going at this wrong? All my software seems to work fine.

Ron Hoffman
Dunkirk, NY

Switching out the BASIC ROM (Read Only Memory) to access the RAM (Random Access Memory) underneath is a fairly common practice among machine language programmers. When you switch out BASIC ROM from within a machine language program, the microprocessor simply continues with the next command within the program.

BASIC itself is a machine language program. As a matter of fact, the BASIC interpreter is running as soon as you turn on your computer. When you enter a com-

mand in direct mode, BASIC interprets the line and executes the machine language code for that command. After the command has executed, the microprocessor returns to the main loop of the BASIC interpreter.

If you switch out BASIC ROM while in BASIC—by entering POKE 1,PEEK(1) AND 254—without first copying this ROM to the underlying RAM, the microprocessor still tries to go back to the main loop of the interpreter when it finishes executing the POKE. The problem here is that the main loop of BASIC, which was stored in the ROM that you switched out, is no longer visible to the microprocessor. Whatever is in the RAM beneath the ROM is what gets executed.

In your case, a 0 happened to be in location 42115 (the beginning of BASIC's main loop). The microprocessor interpreted the 0 as a BRK and executed the warm-start routine. Since this routine resides in Kernal ROM, the microprocessor is able to execute it.

The warm-start routine resets several key memory locations (including location 1) to their default values. Since BASIC ROM is visible by default, it was turned back on by the warm start. To you then, it appears as though BASIC was never switched out.

Entering POKE 1, PEEK(1) AND 253, on the other hand, locked up your machine. Since this POKE also turns off the Kernal ROM, the warm-start code is no longer available to the microprocessor for execution.

Kernal Routines from BASIC

I found the following routine on page 290 in the *Commodore 64 Programmer's Reference Guide*. It positions the cursor using assembly language:

```
LDX #10
LDY #5
CLC
JSR PLOT
```

Is there a way to emulate this routine in BASIC?

Mark Timm
Franklin, WI

PLOT is a Kernal routine accessed through location 65520 which reads or sets the cursor position, depending on the condition of the carry flag. If you clear the carry flag (usually with a CLC instruction—for CLear Carry) prior to calling PLOT, it locates the cursor in the screen position specified in the X and Y registers. Screen rows are numbered 0–24, and columns are numbered 0–39. Thus, your example positions the cursor in the sixth column of the eleventh row.

The same effect can indeed be accomplished from BASIC. Instead of calling PLOT with a JSR instruction (Jump to SubRoutine), you must use the SYS command. BASIC's SYS command obtains the values for the microprocessor's internal registers (namely the accumulator (.A), the X and Y registers, and the status register (.P)) from four memory locations. Location 780 serves as a storage area for the accumulator; locations 781 and 782 store values for the X and Y registers, respectively; and location 783 stores values for the status register (.P). The status register contains a series of seven flags used by the microprocessor. Among these is the carry flag.

So, to mimic this machine language routine in BASIC, run the following short program:

```
10 POKE 781,10
20 POKE 782,5
30 POKE 783,0
40 SYS 65520
50 PRINT1: REM PRINT 1 HERE
```

Lines 10 and 20 specify the row and column position of the cursor. (Try some other values in these lines.) The POKE in line 30 clears all flags, including the carry flag. The SYS in line 40 causes the PLOT routine to execute. And finally, line 50 prints the number 1 at the specified location.

For an example of a program that uses PLOT to locate the cursor, see "A Noisy Cursor" on page 8.

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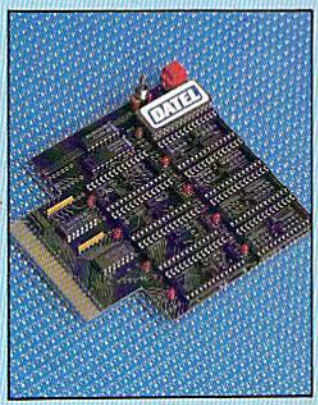

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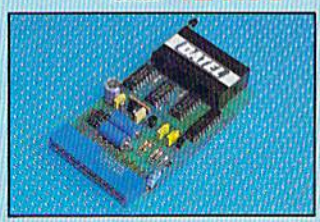

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MIDI Made Simple

Tom Netsel, Assistant Features Editor

MIDI (Musical Instrument Digital Interface) is not a peripheral you plug into your 64 or 128. It's not a piece of hardware or software you order from a computer dealer or pick up at your local music shop. Rather, MIDI is a hardware and software *communication standard* that enables computers and synthesizers to communicate with each other. This concept can be confusing since there's no such thing as *a MIDI*, and you can't hold one in your hand. This abstract quality may have contributed somewhat to MIDI's mystique.

In addition to employing standard musical terminology, MIDI has its own special glossary of buzzwords. Computer owners familiar with such terms as *modem*, *joystick*, and *spreadsheet* may be confused when first confronted with such MIDI jargon as *sequencer*, *librarian*, and *patch editor*.

MIDI's power and flexibility can also be intimidating. One

MIDI

has put computer technology into the hands of many musicians, and it's opened the world of music to many computer enthusiasts. But at first glance, MIDI can be a confusing experience. Where does a beginner begin? What are the hardware and software requirements to begin exploring the MIDI possibilities? These questions and more are answered in this exploration of an exciting new world that merges music and computing.

MIDI-equipped musician can control as many as 16 synthesizers and drum machines, but you don't have to go out and buy 16 different synthesizers to get started. Let's take a brief look at MIDI, explain some of the terms, then see what a 64 or 128 owner actually needs to make music.

Do You Speak My Brand?

Until the music industry adopted the MIDI standard in the early 1980s, each brand of synthesizer spoke its own language. Connecting two different brands was almost impossible. Musicians recognized a need for different instruments to satisfy their artistic requirements, so manufacturers of electronic instruments agreed to standardize hardware, cables, and sockets, and to establish a single protocol for transferring musical information.

Today, as long as an instrument is MIDI-equipped or MIDI-compatible, it can communicate with any other MIDI device via a five-pin DIN cable. Information can be sent over any of 16 MIDI channels. Each synthesizer, drum machine, or other device can be assigned a channel, and that device will play only the music assigned it.

MIDI cables carry requests to play individual notes for a certain duration, but they can carry other information as well. Almost any synthesizer can be programmed to produce different sounds, or *envelopes*. This data can also be sent via MIDI channels. A synthesizer can be programmed to sound like a flute while it plays one portion of a tune, and then can be switched to sound like a violin a few bars later. Such data as timbre, duration, note attack, note release, pitch bend, and vibrato can be included in a MIDI message.

Most MIDI devices can be daisychained like a disk drive and a printer or be connected in other configurations. The devices have ports labeled MIDI IN, MIDI OUT, and MIDI THRU. The MIDI OUT port transmits musical data to another instrument; a MIDI IN port receives it. A MIDI THRU port passes data on to other devices in the chain. In this fashion one musician can control a whole studio of synthesizers from one master keyboard.

The music industry didn't have personal computers in mind when it established the MIDI standard, but computers can easily process MIDI's digital data. A 64 or 128 makes an ideal controller for digital musical instruments, but a special interface is needed to connect the computer to a musical keyboard, drum machine, or other MIDI instrument.

MIDI Interface Card

Technically, MIDI transmits data in a serial mode, but you can't use normal serial hardware such as a modem to handle MIDI information. MIDI sends its musical messages at 31.25 kilobaud, considerably faster than the 300-, 1200-, or 2400-baud rates employed by most modems. A MIDI interface card, which plugs into the Commodore expansion port, handles the necessary signal conversion.

Passport Designs makes a family of MIDI products, and its interface is practically an industry standard. One model comes with additional input and output ports for synchronizing a tape recorder and a drum machine, in addition to its conventional MIDI IN and MIDI OUT sockets. It sells for $199.95. Another version, retailing for $129.95, has a separate sync port for a drum machine only.

Sonus is another company with a full line of MIDI products for the 64 and 128. Its basic interface retails for $85, and it comes with one IN and two OUT ports. Sonus also makes an interface with a tape sync that sells for $149.

Keyboard/Synthesizer

Once you have your 64 or 128 connected to a suitable interface, you're ready to plug into the world of electronic music. The interface itself, however, is not a stand-alone device. It won't let you play a note without an external musical synthesizer or keyboard. You'll need two MIDI cables connecting the computer and the keyboard. Musical notes are sent on one cable from the keyboard to the computer for processing, then are returned on another for playing.

While there are only a few MIDI interfaces for the 64 or 128, you'll find scores of MIDI-compatible keyboards in music stores or music catalogs. Prices range from about $100 to several thousand dollars.

"We don't really recommend [specific] keyboards since there are so many manufacturers," says Jeannie Ditter, Passport's director of marketing. "Our interface works with any MIDI keyboard. Really, the keyboard selection depends on the person's needs, how much money he's willing to spend, and whether

MIDI and the Musician

Larry Cotton

There's a battle being fought over MIDI, and over electronic music in general. Some musicians think it's the best thing that's come along in ages. Others think that it's the worst. Naturally, many musicians are fascinated with the latest equipment, all rack-mounted and interconnected, but how do those marvelous electronic gadgets really sound?

I am a musician, computer enthusiast, and electronics hobbyist, so it was inevitable that I would become interested in MIDI. Several years ago, I built a MIDI interface to connect my Commodore 64 to an electronic keyboard (a Korg DW-8000), mostly to be able to understand what MIDI was all about.

From my experience, I can say that MIDI is definitely not for all musicians. It is for the experimenter, the creator, and the adventurer. If you happen to be a patient, gadget-oriented musician, you may find yourself in seventh heaven.

A Matter of Taste

On the subject of electronically augmented music, musicians can be placed into four groups. Into the first, put the purists—the acoustical addicts—who disdain anything electronic, even amplification, between them and the ears of the audience. These people would no more coddle a Casio than they would stick their hand in an alligator's mouth.

Into the second group, put the electric guitarists and like instrumentalists. Their music is generated acoustically but must be amplified, and is usually modified, electronically.

The third group consists mostly of those people who actually generate sounds electronically. They may be the keyboardists in rock bands. They can't play a lick until their instruments are rack-mounted, touch sensitive, frequency modulated, phase-shifted, MIDIed and split-ear amplified.

In the last group are the creative and adventurous experimentalist musicians. It's well documented that interest in computers and music (and sometimes math) go hand-in-hand. Since you're reading this magazine, you may fall into this category.

What does MIDI offer the musician? What's the first step? Easy: Just look on your instrument for a little round jack that says MIDI. No, there won't be one on the back of your Steinway or at the end of your clarinet. And just because it's a Yamaha doesn't mean it's a DX7. But if it says Casio or Roland or any of a multitude of other names, there's a good chance that you already own the biggest part of your investment in MIDI.

Although just about every imaginable instrument has been MIDIed (including the human voice), the most commonly MIDIed instrument is the electronic keyboard. The older keyboards—synthesizers—had no MIDI jacks. Today all but the least expensive machines are MIDI-equipped.

Some keyboards even feature *sampling*, which digitally records a short segment of any sound that can then be played back under either manual or computer control. At the low end are Casio's miniature sampling keyboards, which can be bought for less than $100. Unfortunately MIDI is not featured.

The quality of the sampled sounds produced by the best machines begins to rival that of acoustic instruments, reflecting the irony that the closer an electronic instrument can emulate the acoustic, the better. In fact, several electronic grand pianos closely emulate the expensive concert grands from which their sounds were recorded. They also have MIDI jacks.

In this month's feature, Tom Netsel says that the music industry never envisioned the interfacing of electronic instruments to computers. But now you can buy keyboardless electronic instruments which are designed to be controlled by another keyboard or exclusively by the computer.

Also MIDIable are reasonably priced electronic drum machines, most of which feature digitally recorded percussion sounds.

Let's assume you own or otherwise have access to a MIDIable electronic instrument. The next thing to do is read an article or two (or even a book) on the subject so you'll have a better feel for what you're about to get into. And please give thought to whether you're one of the purists who can't tolerate the idea of a transistor getting in the way of Tchaikovsky.

If you've successfully hurdled all these obstacles, turn to your 64 or 128. Just plug an interface into the user port, run a cable from it to your MIDI keyboard or other instrument, stick the appropriate software disk into the drive, and you're in business.

Must you have a computer to get into MIDI? No. But to enjoy MIDI you must have either a stand-alone sequencer (it plays the MIDI instrument by itself), another MIDI instrument (one controls the other), or a computer (it can do many things in addition to playing the instrument—see the accompanying article).

Beyond Muscle and Brain

How do MIDIed electronic instruments sound? The same way they did before MIDI. Only faster. Or richer. Or stranger. With MIDI, a musician can begin to explore ideas and sounds that are impossible to create with human muscle and brain cells.

For instance, the human hand can reach only a little over an octave on a keyboard. A MIDIed electronic keyboard can often play up to eight notes simultaneously, stretching from its very lowest to its very highest. It can play "The Minute Waltz" in a few seconds. The human imagination is its only limit.

If you liked your keyboard or other electronic instrument before MIDI, chances are you'll love it with MIDI. In my opinion, a computer and electronic instrument MIDIed together go far beyond simple sequencing. A computer, properly programmed, is fully capable of creating random patches (customized sounds) that the musician simply had never dreamed of. And the computer is very valuable at remembering and storing in its disk library these patches for easy and fast retrieval.

I, for one, don't believe that electronic instruments will ever replace acoustic ones, nor do I believe that computers and MIDI interfaces will ever replace musicians. The human being must still be there to furnish the creative spark, the enthusiastic imagination, and the patience to take advantage of what MIDI has to offer. There will always be needs for the complementary technologies, and the human being will be right there to push them all to the limit.

he's going to be performing professionally or just in the home."

Dr. T's Music Software is another firm that offers a full line of software for the electronic musician. Dr. T spokesman Jeff Pucci says many people getting started with MIDI select the Casio CZ-101 keyboard.

"That's a pretty good multitimbral synthesizer for under $300," he said. "It can play four instrument voices simultaneously, so you're getting a lot for your money. That's really a good first choice."

Sonus sales manager Erin Axtell agrees. "For a first-time user, usually Casio gets chosen because it's inexpensive and it's MIDI-compatible."

Axtell says any MIDI keyboard will work. It just depends on what you want, and how much money you're willing to spend. Most keyboard makers offer a wide line of products, ranging from entry-level to professional-quality. "Yamaha and Roland are the hottest-selling brands on the market right now. Roland's D-50, Yamaha's DX7 II-FD, and the ESQ-1 and ESQ-80 from Ensoniq are all popular," Axtell said.

Very few electronic keyboards have built-in speakers. Most have a jack for headphones, but you'll need an external amplifier and speaker system for normal listening. If you don't need the power to rattle the rafters in a concert hall, a home stereo system is adequate for most amateur musicians.

You don't necessarily need a computer to produce different *voices*—sounds or timbres—on

some electronic keyboards. These voices, mimicking violins, trumpets, oboes, flutes, and other instruments, may be referred to as *presets*, and they are permanently stored in the keyboard's memory, which is similar to a computer's ROM. If, however, you want to see what MIDI can do, hook a keyboard to your 64 or 128, and get some software to put all the pieces to work.

Sequencers

A glance through the accompanying "Buyer's Guide" finds more than 30 programs that utilize MIDI. Selecting the proper software can be confusing for someone just starting. The experts at Dr. T, Sonus, and Passport all recommend a *sequencer* as a beginner's first software purchase.

A sequencer turns your 64 or 128 into a multitrack recording studio. You can record a melody on one track, record a bass line on another, lay down additional melodic lines on still more tracks, then play them all back in sync. Most sequencers offer 64 and 128 owners a minimum of eight tracks.

A sequencer is similar to a tape recorder in that it offers such features as fast forward, reverse, and rewind, but it's much more versatile. If you make a mistake while recording with a tape recorder, you have to start again from the beginning. A sequencer lets you correct the mistakes, editing individual notes. What's more, it lets you make other changes that would be impossible with a tape recorder.

Once the composition has been recorded, you can play all the tracks back together. Music can be played faster or slower without altering the pitch or key. If you decide your composition would sound better in another key, you don't have to scrap your previous efforts. The sequencer can change the key for you. It can also change the time signature or tempo with just a few keystrokes.

If your talent on the keyboard is limited, you can enter notes one at a time, editing the tempo, pitch, velocity, and duration of each note. Then play back the final mix at any speed you like. Most sequencers offer this *step-time* form of entering notes from the computer keyboard, as well as *realtime* entry from the synthesizer keyboard.

Just like a word processor, music software lets you cut and paste—only you're working with musical sequences rather than words. Copy them, append them to themselves, or move them anywhere in the composition. You can even switch sequences from one channel to another.

If your timing is a little off, most sequencers can automatically correct tracks to any resolution from quarter notes to thirty-second notes. This is often referred to as *quantizing*. Time signature changes can also be inserted anywhere within a sequence.

Now that we've seen what a sequencer can do and the musical control it can provide, let's take a look at some of the popular titles available for the 64 and 128.

Master Tracks. Passport's Jeannie Ditter recommends her company's *Master Tracks* sequencer. "It's our

MIDI by Modem

Further information about MIDI is as close as your Commodore, modem, and telephone. Text files, music files, patches, product reviews, answers to MIDI questions, and more can be found on bulletin boards.

The East Coast MIDI Bulletin Board in Coram, New York, was designed with the MIDI-phile in mind, and it attracts callers from Europe and Asia, according to sysop Gene DeLibero. This BBS offers online support for professional musicians and beginners alike—message centers, expert advice, hints and tips, plus hundreds of downloadable text files, programs, and patches for practically all synthesizers.

ECM also offers MIDI software and hardware for the 64 and 128. There is a yearly membership fee for accessing the various conferences. The East Coast MIDI Bulletin Board supports Commodore, Apple, IBM, and Atari computers, and can be reached 24 hours a day at (516) 928-4986.

Other MIDI information can be found on the Commodore Information Network on QuantumLink. A variety of computer/music information is available in the Music Room, which includes a section devoted to MIDI. It supports message boards, libraries, MIDI programming packages, text information, and daily MIDI conferences.

QuantumLink has a large library of music files available for downloading. There is a huge listing dedicated to the Commodore SID chip, but the service has a program that allows you to play these files on MIDI. The QuantumLink customer service number is (800) 392-8200.

Type MIDI when you log on to GEnie, and you'll find yourself at the MIDI/World Music Roundtable. Sysop Bob Moore conducts live conferences from computer trade shows and with professional MIDI musicians such as Greg Welchel and Mark Ritter, keyboard players for the Pointer Sisters.

The library contains public domain sequencers and librarians, patches, and song and sound files for almost every computer. The MIDI 1.0 specifications are on file for downloading, for those interested in the technical aspects of MIDI. An accompanying file explains many of the technical terms.

A message base provides a forum for the exchange of musical information, questions and answers, and product descriptions in the forum's 14 specific MIDI categories. Call (800) 638-9636 for registration information and rates.

CompuServe offers a forum called MCS MIDI. Type GO MIDI after logging on to access the data library, message bases, and files. Specific message categories include general music topics along with topics such as computers and music, music and software, synthesizers, percussion, recording, and performances.

Sound patches and banks for different formats are available. Live conferences let you pick the brains of various experts in the field of music. Also available are highlights of articles appearing in *Music, Computers, & Software* magazine, the SIG's organizers.

The Source recently opened a new special interest group (SIG) for musicians and music enthusiasts. Music SIG is intended to serve as a place to share ideas and interests and keep up-to-date on the world of music.

Music SIG focuses on top 40/ pop, classical, rock and roll, and alternative music. Music SIG also provides patches for MIDI enthusiasts. Rounding out the offerings are reviews of new releases and performances, ranking charts, and expert advice. To enter the forum, type MUSICSIG at Command Level. Registering information is available at (800) 336-3366.

Music City is the SIG for MIDI information on Delphi, where numerous professionals help with live music conferences. Delphi also provides message bases and numerous MIDI files for downloading. For more information or to register with Delphi, call (800) 544-4005.

The Performing Artists Network has more than 400 megabytes of MIDI information in its files, but membership is restricted to professional musicians. The network also includes booking information, club and college contacts, radio listings, tour support, and other services to help promote professional musicians and the international MIDI industry. The Network's BBS is run by Perry Leopold, who also handles the chores at Delphi and The Source. Call (215) 584-0300 for information and rates.

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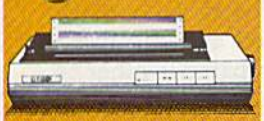

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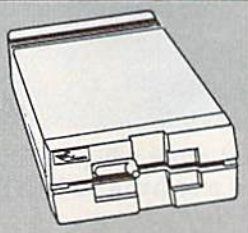

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most popular for the Commodore," she said. "This is a versatile sequencing program that allows you to do a lot of different MIDI applications. It's easy to learn, but it's not something that you'll get bored with or quickly outgrow."

Master Tracks is a 16-channel, full-featured sequencer that allows you to compose, arrange, and orchestrate with one program. It retails for $249.95. *Master Tracks Pro* ($299.95) is an enhanced version of the sequencer for the Commodore 128 that takes advantage of the 128's larger memory.

MIDI/8 Plus. Passport also offers an eight-channel sequencer called *MIDI/8 Plus.* It sells for $149.95. "It's a very simple program that doesn't have the features of *Master Tracks,*" Ditter said, "but it costs less. If people are seriously interested in music, we often suggest they get right into *Master Tracks,* because it does allow them to have more options."

Keyboard Controlled Sequencer. Dr. T offers the *Keyboard Controlled Sequencer* for the 64 ($149) and for the 128 ($225). Both permit editing and structuring of music entered by computer or synthesizer keyboard in realtime and step-time entry. Sequences can then be chained together in songs. The 64 version holds 3,500 notes and 35 sequences. The 128 version stores 12,000 notes and 126 sequences. The 128 version also allows you to split the synthesizer keyboard, allowing you to assign the upper and lower half to different MIDI channels.

GlassTracks. At Sonus, Erin Axtell recommends the *GlassTracks* multifunctional sequencer. "*GlassTracks* is easy to understand, but it's a very professional program," she said. "I suggest it for any beginner. It's perfect for them." *GlassTracks* offers standard controls, with fast forward/reverse, assignable channels, and names for each of eight tracks. Tracks can be transposed, erased, and quantized to the nearest thirty-second, sixteenth, or quarter note. Its suggested retail price is $69.95.

Super Sequencer. Sonus also offers a Super Sequencer series for the 64 ($189.95) and the 128 ($229.95). This is a multifunctional, professional line of MIDI recording software offering 16 sequences, 8

tracks, and other advanced editing features. It also has a built-in librarian (see below).

Patch Editor/Librarians

Many keyboards come with sounds, or presets, built in, but MIDI software can also create violin, piano, flute, or other effects. These programs, or *librarians,* facilitate the storage of the synthesizer parameters so they can be easily and quickly installed. Such MIDI-produced sounds are often called *patches,* a term stemming from the early days of analog synthesizers, when *patch cords* were needed to program the effects. To add to the confusion, these same programs are often called *patch editors* or *patch editor/librarians.*

If you have a Casio, a Yamaha, or another popular synthesizer, there are specific librarians available for your keyboard. They let you create, edit, and store patches on the CZ-101, DX7, or other specific keyboards. Some programs include hundreds of preprogrammed patches. You may want to consider a librarian, but it's not required software for MIDI beginners.

Scorers

Many musicians feel it's important to have a hardcopy of their music. After entering a composition, editing and recording it with a sequencer, and playing it through a synthesizer, they like to have the option of sending the final product to a printer. Once again, as with librarians, you don't have to have this type of software to get your feet wet with MIDI, but it is useful to some beginners.

Passport offers *The Music Shop for MIDI,* retailing for $149.95. It lets you compose, edit, and print sheet music in piano, single staff, or quartet formats. Eight voices can be assigned to four different MIDI channels or keyboards. *The Music Shop* doesn't have the sequencing capabilities of *MasterTracks,* but *MasterTracks* doesn't have printout capabilities. *The Music Shop for MIDI* requires a graphics interface and printer that can emulate Commodore graphics.

Dr. T has *Convertafile Plus,* a utility program that converts *Keyboard Controlled Sequencer* or *MIDI/8 Plus* files for use with Passport's *Music Shop for MIDI.* It handles transcription for sequencer files, automatic transposition of parts, and autocorrection. The program retails for $75.

Determine Your Needs

MIDI is not a computing activity that will interest everyone. To be accurate, it's a musical activity that uses a computer as a creative tool. Related software tends to be more expensive than games and other forms of computer entertainment, and keyboards can be a major purchase. If you have an interest in MIDI, ask yourself a few questions before deciding on a keyboard or a sophisticated sequencer.

How much of a beginner are you? Are you new to computers, music, and MIDI, or are you a trained musician who's just starting to make electronic music? Do you plan to play professionally or just for the enjoyment of it? Would you be content with a basic, no-frills keyboard, or do your skills and standards require professional-quality instruments?

Finally, how's your budget? You may want a top-of-the-line synthesizer, but can you justify the expense? MIDI software (and hardware) is specialized and still has a hefty price tag compared to other 64 and 128 software. If you just want to plunk out a few tunes, MIDI may be musical overkill. Exploring the possibilities of Commodore's SID chip could be a more economical release for your musical talents.

If you're still determined to turn out MIDI masterpieces, you'll need, in addition to your 64 or 128, a keyboard/synthesizer to produce the notes, a sequencer to control and record your creations, and a MIDI interface to connect the computer to the keyboard, and that's it. Start with this simple setup; then check out the accessories.

Of course, a dash of talent doesn't hurt, but you have to supply that.

Talk Is Cheaper

Mickey McLean

Even as manufacturers of speech-synthesis and voice-recognition products debate the future of the Commodore 64 market, they continue to attempt to improve performance while lowering prices. Although there have been no recent major breakthroughs in technology, most of these companies have brought their prices in line with an average 64 user's budget.

Following the introduction of the 64, several companies decided to take advantage of the computer's SID (Sound Interface Chip), which was—and, for some purposes, still is—considered one of the industry's best. Commodore itself released a voice-synthesis module called the Magic Voice, which has been discontinued for some time. Most of the other speech-synthesis companies have either ceased to exist, have merged with each other, or like Commodore, have discontinued their products for the 64. Some, though, have forged on.

Speech-synthesis and voice-recognition products for the 64 and 128 are now more affordable than ever—and there's a lot to choose from.

Three Parts of Speech

Currently there are three basic types of speech technology available for microcomputers. *Speech digitizers* convert spoken words into a series of numbers, which can be read by the computer and then sent to the sound chip to be replayed. *Speech synthesizers* divide words into phonemes (the smallest meaningful sounds in a language). The phonemes are then linked together to form audible words. Finally, there's *voice recognition*, which enables the computer to digitize the user's voice and then match the digital pattern of a word to a previously digitized command. The computer hears and interprets the word, and then it performs the designated function.

Chip Off the Old Block

Covox has been marketing its Voice Master system for several years. This speech-digitization and voice-recognition product allows users to record and play back speech, to train their computer to recognize words, and, with *Speech Construction Set*, to edit both the pitch and amplitude of digitized voices. The Voice Master package (which includes *Speech Construction Set* and a headset) has a suggested retail price of $89.95.

Voice Master Junior is a low-cost alternative for 64 users.

Last year, Covox released a lower-priced, scaled-down version, the Voice Master Junior. It's physically smaller than its predecessor, but has many of the same functions. The Jr. doesn't include a headset or the Voice Master's fundamental pitch and amplitude extractor circuitry, and it won't work with *Speech Construction Set* software. The suggested retail price is $39.95, and an optional headset microphone can be purchased for $10.

Covox vice president Brad Stewart said that his company realized that a lower-priced alternative was necessary for Commodore users.

"We wanted to keep the 64 market open and make it more attractive, and we did that by tweaking performance and lowering the price. We've now got it down to about the same price level as games," Stewart notes.

Another company that has been in the voice-technology business for several years is Votrax. Their Votalker 64 is a speech synthesizer that fits into the 64's expansion port and uses 8K of memory. It originally sold for $99.95, but recently the price was reduced to $59.95. Users type in the words they want the computer to say. The volume, pitch, and the speed of the speech can then be altered.

Educational Speech

Hearsay has produced most of its speech-technology products for educational use. The company's software is designed to be used with the Hearsay 1000, a combination speech-synthesis/voice-recog-

nition peripheral. The 1000 plugs into the 64's expansion slot and comes bundled with software that allows user-programmed speech. The standard Hearsay 1000 is sold in mass market stores such as Toys "R" Us, and retails for $59.95. The Swift Load version, which allows users to load the software five times faster than the standard version, sells for $79.95.

Two of Hearsay's educational programs are *Aqua Circus* and *Think Bank;* both require the Hearsay 1000. Hearsay is also planning to release this summer *The Intelligent Talking Terminal,* which can be used with databases and online and bulletin board services.

Michelle McNamee, regional sales director for Hearsay, says that they're working with several large software publishers on approximately ten new voice-interactive titles to be released by the end of the year.

In addition to working with its own specially designed software, the Hearsay 1000 can also work with other software. Users are able to issue verbal commands in text adventures such as *Zork* instead of typing them in.

Fearn & Music also markets a sound-digitizing product. The SFX Sound Sampler is manufactured in England and was picked up for distribution by Fearn & Music last November. The sampler allows users to edit sounds and shift pitch (which can make a male voice sound like that of a female, and vice versa). Fearn & Music has also dropped its price of the Sound Sampler from $127 to $89.

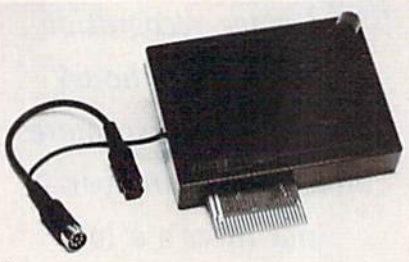
Another recent release—and a rather unique product—is Access's Lip Stik Plus, a headset/mouthpiece that detects sounds which activate the fire button used in action games. Since the product reacts to any sound, it cannot perform voice-recognition functions. The original Lip Stik is packaged with the 3-D space-flight simulator *Echelon* and can be used with that program only. The Lip Stik Plus can be used with most games that use a fire button. It retails for $24.95.

More Than Entertainment

Speech-synthesis and voice-recognition products can provide users with more than just software enhancements. Handicapped users can benefit greatly.

Visually and physically disabled individuals can make keyboard entries verbally instead of manually. Using software such as Covox's *Speech Construction Set,* people with hearing disorders can receive visual feedback detailing where their voices rise and fall.

Michelle McNamee of Hearsay offers one example of a handicapped individual who uses their product. "We know of a gentleman in California, who is a paraplegic and whose wife is blind, that uses our products. He also works with schools for the handicapped with our unit."



The Hearsay 1000 is a speech-synthesis/voice-recognition device that plugs directly into the 64's expansion port.

McNamee adds that the Hearsay 1000 is also being used by many blind computer enthusiasts in Britain.

Talking Crystal Ball

The future of voice-synthesis and -recognition products for the 64 depends, of course, on the future of the Commodore 64 market, as well as whether software developers produce programs that require the technology or take advantage of it.

Electronic Speech Systems does speech-production work for software companies as well as for the toy and automotive industry and the military. They designed the digitized speech for games such as *Impossible Mission* and *Ghostbusters.* They have also worked with manufacturers of Nintendo game cartridges, which, according to company president Fred Chan, is a growing market for the company.

"Speech and sound add a lot to a game," Chan says. "The Nintendo games we've worked on are big sellers. Software companies should be doing the same thing. It could add 10 to 15 percent in sales."

Even as speech products become more affordable for Commodore users, many companies are spending their time developing advanced speech technology for IBM PCs and compatibles.

Covox, for instance, has recently released a new line of voice products for the PC and plans several new releases later this year.

Although the company has not abandoned the Commodore market, Covox's Brad Stewart says they realize that their future may lie elsewhere. "The user base of the 64 will level off and our sales should do the same.

"Voice recognition for the 64 is really just a curiosity," Stewart notes. "You really need a bigger machine [more memory] to do it properly." He adds that PC users tend to spend a little more money, which is another reason why that market may be more viable, or at least more attractive.

On the other hand, Hearsay is confident in the Commodore 64 market and continues to develop products to take advantage of the SID chip.

"The 64 has just risen again," says Michelle McNamee. "I've seen it in our sales figures since October of last year."

She adds another reason for the renewed success of the 64. "There are a large number of people with small children, and the 64 is easy for children to learn to use."

For more information on products in this article, contact:

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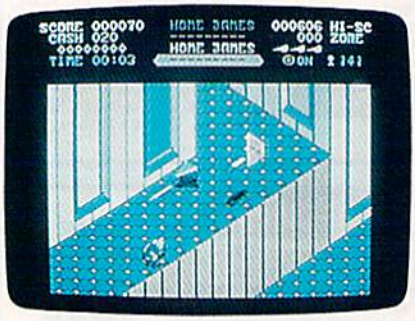
Zig-Zag and *Plasmatron*

I spend most of my waking hours writing, thinking, programming, and praying for peace, so I don't think I have to apologize when I break away for a few minutes of harmless vicarious violence. Second-hand thrills have a healing quality. That's why war movies, videogames, and pornography are so popular. Who's to say whether playing a few videogames might have soothed Hitler's feelings after being rejected from art school? He might not have embarked on his second career. A clear example of the benefits of videogames is the fact that we have not engaged in a major European conflagration since the introduction of *Pong* in the midseventies. Mere coincidence? I think not.



Zig-Zag

This review concerns two recently released action games. *Alien-blasters* would be a more accurate term. Blast the alien in whatever form. Eradicate the enemy. Crush the opposition. It's better to do it on the computer screens than in the streets.

Tired of the arms race? Politicians giving you a pain? Get lost in the Matrix of Zog by playing *Zig-Zag*. To set the record straight, the game is *Zig-Zag* and the company is Spectrum Holobyte, although I found the package labeling a little confusing on this point.

The game itself leaves no room for doubt: Creators Antony Crowther and David Bishop have produced a fascinating alter reality. The Matrix of Zog will remind you of a cross between Versailles and a 1930s bijou. Colors flood the screen. The animation is incredible, and gameplay will call upon a unique set of skills.

Flashy graphics wait for you at every turn. The score screen will knock your eyes out. And before the game is even played, you're treated to a frontispiece screen, a display that is simply gratuitous glitz. The credits crawl as if at the beginning of a movie, with mention of such functions as key grip and lighting. And the credits are accompanied by a catchy techno-rock score. What a crew of programmers! My hat is off to them.

The game itself will probably sound a mite ridiculous. But don't let that dissuade you. This game is special.

Leave tiresome physics behind when you enter the Matrix. Zog plays by his own rules. You won't be able to steer your spacecraft. You can sidle left and right, rise and fall, but you can only go in one direction, unless you hit one of the prisms helpfully scattered among random nooks and corners. (I warned you this was going to sound a little strange.)

A prism (they look a little like orange coal scuttles) allows you to turn at a right angle. If you hit a wall, you bounce off undamaged and proceed in the opposite direction. The hallways swarm with zigzags, homers, drifters, attracters, bouncers, corkscrews and cubes. It sounds like a bar on the waterfront. But it doesn't matter what they're called—it's always open season. Exterminate them.

These two new action games produce a fascinating alternate reality.

As they bite the dust, you'll accrue cash (yen, hopefully, in the light of worldwide moneymarket trends) with which you can purchase helpful items like shields, smart bombs, maze maps, x-ray vision, and so on. There is so much more, I could go on for a long, long time.

Zig-Zag is a game that will draw your eye from a long distance away. You'll find yourself helpless in its grip.

The second game I played recently is *Plasmatron* from Avantage. *Plasmatron* is a spectacle. As you pilot your jet through throngs of attacking fighters from the hostile empire, you must fight also against the distraction of the fine graphics. Nearby buildings, mushrooms, ferns, and the like rush by much faster than distant objects (which include a Saturn-like ringed planet), lending a disturbingly realistic third dimension to the game.

Plasmatron

If I have any objection to this and other similar games (like *Sanxion* and *Delta Force*), it's that the fighter ought to move through this third dimension as well. As it is, your fighter and the aliens are on a single plane in the foreground, which usually seems somewhat removed from the background.

The background isn't just pretty pictures, though. The factories are on fire and their smoke represents a major hazard. Call the EPA later—you won't have time to think when playing *Plasmatron* (which is probably the highest praise that can be given to an action game).

—Robert Bixby

Zig-Zag
Spectrum Holobyte
2061 Challenger Dr.
Alameda, CA 94501
$24.95

Plasmatron
Avantage
20813 Stevens Creek Blvd.
Cupertino, CA 95014
$14.95

PaperClip III

The Commodore 64 has never been short of quality word processing software. *WordPro 3 Plus* almost coincided with the release of the 64, and it established a surprisingly high initial quality. Following *WordPro 3 Plus* came a host of other entries, from *Paperback Writer* through *Word Writer* through *Fleet System* through *SpeedScript* through *GeoWrite Workshop*. Almost amazingly, all were of a very high quality.

But the best one of all was *PaperClip*. Filled with features and thoroughly professional, *PaperClip* became the main word processor for a great many 64 users. *Omni* went so far as to call it the Cadillac of word processors. Almost by itself, it established the Commodore 64 as a machine worth using even by the serious writer. It couldn't do anything about the 64's lack of an 80-column mode, but it made up for it with a wealth of flexibility. Several versions of the package, and finally a *PaperClip II*, expanded its initial capabilities.

When Electronic Arts acquired the Batteries Included line, 64 owners hoped that *PaperClip* would be among the products saved from extinction. It was more than just saved; it was injected with a new youth. *PaperClip III* has now been released, and it's still the Cadillac.

Inside the package are a 200-page manual and two double-sided 5¼-inch disks. The two disks are an important feature: One contains a version for the 64, the other a version for the 128. On the back of the 64 disk is the Dictionary disk (for spell checking), while the reverse of the 128 disk holds the dictionary and the printer files.

What this means, of course, is that former 64 users who have upgraded to the 128, but who have kept their 64, have actually purchased two new products.

Experienced *PaperClip* users need not fear extensive revisions. Except for some useful upgrades, the program works exactly as before. For those new to the program, Batteries Included has added a series of menus, accessible through the function keys. These menus bring *PaperClip III* up to the ease-of-use standards set by menu-driven word processors such as *GeoWrite Workshop* and *Pocket Writer*. Menus, of course, have become the *sine qua non* of all productivity software.

There are several menus, but the main menu, summoned by the F7 key, is typical. When the main menu is on the screen, the cursor keys highlight one of several options. New Document erases the text in memory (*PaperClip III* does not allow multiple windows) and lets you start over. Both Load Document and Save Document are self-explanatory, while Disk Directory brings the directory onto the screen.

From this menu you can also search text, search and replace text, get a video preview of the document, print the document, invoke the spelling checker, and move to the telecommunications module. Also, from here you control margin settings and justification. When you have everything set, you can save the configuration to disk.

All of these commands are accessible through the keyboard as well. Experienced *PaperClip* users will recognize the Save command as Control-S, the Directory command as Control-0 (or CTRL-1), the Video Preview command as Control-V, and so on. None of the menu commands replace the old keyboard commands; they simply make learning the system much easier.

What does *PaperClip III* have to offer? A number of things. First, it's a postformatting word processor, which means that the document does *not* appear on the screen as it will on the printed page. This may seem like a disadvantage, but in fact it allows total control over what the document will look like. It also doesn't slow down your typing fingers, as many WYSIWYG word processors do.

PaperClip III *is still the Cadillac of word processors for the 64 and the 128.*

Second, it offers thorough flexibility. Through a series of formatting commands, all of which follow the check-mark symbol, you can control margins, page length, pitch, spacing, header and footer information (including multiple-line headers and footers), page numbering (including upper- and lowercase Roman numerals), chapter numbering (again with Roman numerals), and linking several files together to create a text longer than memory allows.

Speaking of this, the price of more features is less available memory: Commodore 64 in-memory documents are now down to 202 lines (from over 800 in the earliest *PaperClip* versions), while 80-column 128 documents are 499 lines.

Check-mark commands include such esoterica as interparagraph spacing (automatic multiple-spacing between paragraphs); alternate page printing, which allows you to print first the odd-number pages, then turn the paper around and print the even-number pages on the back; proportional printing; letter-quality printing; automatic paragraph indention; forced paging (with conditions); and even outlining.

What else? *PaperClip III* lets you take the Directory screen and put it into text, a useful feature for cataloging disks. It has a Global File Copy command, available for two-drive owners only, which copies all of a document's linked files from one disk to another. It has one of the most sophisticated column manipulation features of any word processor for any system, and it allows table of contents (but not index) generation. The 128 version even has a command for stripping hard returns from a text file you receive over a modem.

The telecommunications module comes, like the spelling checker and the setup and configuration files, by way of an overlay that stays out of memory until you invoke it. Special features here include the recognition of various Commodore-based modems (and Hayes and other RS-232 modems), dialing commands, autolinefeed commands, and three transfer protocols, Xmodem CRC, XModem, and Punter C1. The Punter protocol is used by some Commodore-specific bulletin board systems.

PaperClip III more than holds its own in the rather crowded 64/128 word processing field. It's probably the least pretty of all such packages, and will therefore not appeal to those who want their screens to look as good or better than their printed documents.

But for anyone looking to make their 64s—and especially their 128s—professional word processing stations, *PaperClip III* will satisfy virtually all their wishes. I have used word processors on mainframes, on the Amiga, on the Atari ST, on the Macintosh, and on MS-DOS machines, and I still find myself drawn to *PaperClip III* on the 128D.

The program's first version has a couple of bugs, however. First, the up-arrow key (the one beside RESTORE) does not operate in the 64 version. Functionally, this means that putting page and chapter numbers in the text will not work (they will still work in the headers and footers, though).

Second, the printer test in the 128 version causes the program to crash; the 64 version seems to work fine, however. Finally, less a bug than an annoyance, the CTRL-O combination for printer output does not operate in the 64 version. Instead, you have to print by using the menus in the overlays.

—Neil Randall

Batteries Included
Distributed by Electronic Arts
1820 Gateway Dr.
San Mateo, CA 94404
$49.95

Power at Sea

Obviously, the more literary title has already been used by Hollywood for the still moving, still televised *Victory at Sea*. And there is no doubt that *Power at Sea* has more connotations of arcade parlors than it does of history. Yet there's no escaping the fact that *Power at Sea* is a celebration of the gallant hours of Admiral William F. "Bull" Halsey. Furthermore, I know Accolade is feeding me history in small doses—and I love it.

This time it's the Battle of Leyte Gulf, one of the greatest naval confrontations of all time. Admiral Halsey commanded the U.S. Fleet during this battle that opened the way for the liberation of the Philippines. He dealt the Japanese Fleet a crippling blow by sending Marine units ashore in a successful land invasion. The question in *Power at Sea* is whether you can do the same.

For all practical purposes, you're an admiral, although your fleet is small: one battleship, one aircraft carrier, and one troop ship. But with these vessels, you may do wonders. During the initial moments of the game, decide between carrying a large number of troops or a great amount of fuel.

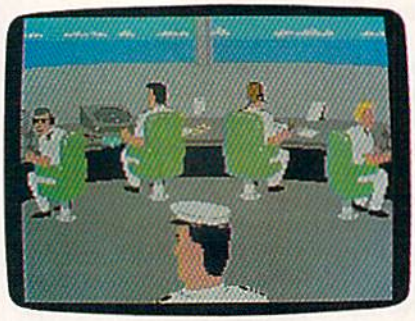
You'll also have to decide on the ratio of fighter planes to bombers. You may have many of one or the other, but not both. Striking the proper balance is one of the key strategic moves, and yet the choices can be based on your own arcade talents. If you become adept at using the big guns to knock out shore installations, you won't need so many troops; if you're a good pilot, you won't be wasting airplanes.

Go to your flagship's bridge, which is a menu in disguise. At their stations, you'll see a radioman, a navigator, and damage control and weapons officers. When one of them desires your attention, he'll turn his head toward you. When you query or give orders, use the joystick to turn your head (in the foreground) toward one of them.

Audible tones alert you to radio messages no matter where your attention is engaged. Return to the bridge, face the radioman, and a summary of messages appears on a screen.

Querying the navigator shifts the screen to a map of Leyte Gulf, where enemy installations are marked. Since you have only 96 hours to break the enemy fleet and successfully invade four enemy bases, you'll want to be thoughtful about how you set your course. Set your rendezvous points, set your speed, and the battle is on.

When danger threatens, you'll learn about it from the radioman. Go to the weapons specialist, and the screen shows several courses of action, with



the proper one highlighted.

Now you're into the arcade part of the game. If an enemy battleship is near, launch planes to take it out, fighters to silence its guns, and bombers to finish it off. As each plane embarks on the mission, you'll be at the controls. When a plane finishes its run, you'll switch to the next aircraft in line.

Kamikaze planes made their first appearance in this battle; sometimes threats will come at you from the air. When this happens, man antiaircraft guns and try to shoot down the waves of attackers.

Power at Sea is arcade action plus a dose of history—the Battle of Leyte Gulf, one of the greatest naval confrontations of all time.

To soften an enemy base for invasion, man the big guns and try to knock out the gun emplacements on shore before they knock you out.

As each offensive or defensive action loads, you're treated to a montage of images, much as you've seen in movies: sailors running to their stations; lookouts observing the enemy through binoculars; fliers pulling on flight jackets.

While the success of your actions depends upon your joystick skills, the final act—land invasion—relies on strategy. You'll be told the relative strength of the enemy base. From this description, you must decide how many troops to commit. By toggling your joystick, you can select in multiples of 100 up to a maximum of 1200 troops.

While it probably seems easy enough to commit the full force to each invasion, bear in mind there are several enemy bases to be reduced, and even victorious U.S. troops are not to be returned to ship. They presumably are on occupation duty or mopping-up operations.

Once troops are committed, you can only wait—as commanders have done throughout time. Again, a montage of images plays about the screen, with appropriate sound effects. Now and again short messages appear at the bottom of the screen: "Sir, we've secured the beach." "Sir, we're taking heavy casualties." "Sir, we need reinforcements."

If your troops are successful, the final image of the montage will be out of context but no less stirring: Marines raising the flag on Iwo Jima, an event that happened a few months later. Their hymn plays in the background, and the captured base on the navigation map will be reflagged with the Stars and Stripes.

It isn't always victory, however. Your aircraft carrier may be too damaged by Kamikazes to launch any planes; your big guns or antiaircraft guns may be too damaged to fire; you may be hopelessly run aground; you may have no more troops, fuel, or time. You were given 96 hours to complete your mission. If it isn't accomplished, or if you succumb to the enemy, you'll be removed from command: The familiar scene on the bridge is there, but you aren't.

Whatever the outcome, the scoreboard shows where you succeeded and where you didn't. Each element of the game is considered separately. The positive and negative numbers result in a numerical score and a rank on the "Hall of Fame" board. (Privately, I wonder why a Commander outranks an Admiral, but that's a matter for Accolade to sort out.)

Documentation is slight but complete. I would have appreciated the deeper historical background that Accolade has traditionally included with such games. Graphics and sound, as usual, are very good, and the Accolade "trademark" of large foreground graphics is evident.

As an arcade/strategy game controlled by a joystick, *Power at Sea* tests your mind and reflexes in ways that should certainly hold your interest. I ask no more of any game. As a means of spotlighting a few gallant hours of history—reminding us of a time when young men in blue dungarees and baggy khakis held our future in their hands—it works.

Thanks, Accolade, for the memory.

—Ervin Bobo

Accolade
550 S. Winchester Blvd.
Suite 200
San Jose, CA 95128
$29.95

Hodge Podge

Children are delighted by simple things. Blocks, balls, bright colors. They like surprises, too. *Hodge Podge* by Artworx has all these things and a little bit more. It offers a way to simplify your computer and make that magical toybox accessible to your children.

Hodge Podge's goal is to introduce your children to handling the computer keyboard, and to educate them a little at the same time. Unlike most games which require at least rudimentary reading skills, *Hodge Podge* requires nothing more than little fingers and active curiosity. You load up the program and then let the child take over.

There is a programmed response for nearly every key on the keyboard. When a child begins to press the keys, the fun begins. The responses are consistent and bear some relation to the keys that prompt them. For example, pressing F will call up a picture of a barn and the tune to Old Macdonald's Farm followed by—at the appropriate moment—a randomly selected animal. Older children soon develop an awareness of the relationship between keys and screen and are able to call up desired favorites at will.

Most of *Hodge Podge*'s graphics are extremely simple, but this seems to be intentional. The cheerful colors and blocky designs have ankle-biter appeal. It's this simplicity that makes the program deceptive. It just doesn't *look* like it does as much as it actually does.

Many of the drawings are animated or have musical accompaniment, and all have the potential for teaching. There are the alphabet and counting lines and musical scales, but there are others which educate more subtly than these. When a song is played, the corresponding notes appear in the lower right corner of the screen. Some keys provide thought-provoking pictures such as a prism breaking a streak of white light into a series of many colors or a volcano erupting. When older children play, these kinds of pictures can serve to stimulate discussion.

The short sequences used in *Hodge Podge* are just right for capturing a youngster's attention span. They're reminiscent of some of the animations on "Sesame Street." In fact, *Hodge Podge* is sort of an interactive "Sesame Street," where a child can prompt his or her own entertainment, be educated, and become familiar with the computer all at once.

Hodge Podge fills a niche: It's a computer game for the youngest members of the family: 18-month-olds are delighted by it. Even sophisticated six-year-olds enjoy the music and the surprise of the random selections. The most fun is to turn an older and younger child loose on it together.

The two-page manual gives a complete run-down of what response each key will bring. It refers only to the Apple and Atari versions, so there are no loading instructions for the Commodore. Of course, most 64 owners are smart enough to figure them out; at the same time, this is an unfortunate oversight on the part of Artworx.

The phrase *hodge podge* means *mixture* or *jumble*. Artworx's *Hodge Podge* is exactly that: a jumble of pictures and sounds designed to please the eyes and ears of its audience. With it, your computer becomes a magical toybox that your children can open up themselves to discover what lies inside. And for a child growing up in a computer-using society, that introduction can be the biggest magic of all.

—*Robin and David Minnick*

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Star NX-1000C Multi-Font Printer

I took a cold, hard look at my computing requirements some time back and decided I *needed* a daisywheel printer. Of course, what I *wanted* was a dot-matrix printer able to print graphics, banners, and other fun things, but my business requirements had to come first. While it might be fun to dump high-resolution screens and print greeting cards with quadruple-sized letters, I felt I needed the print quality that only a daisywheel could provide.

Then along came Star's NX-1000C Multi-Font.

The print quality of dot-matrix printers has improved in the past couple of years. Most printers now have a near-letter-quality (NLQ) mode, but the quality varies from machine to machine. (On some printers I think NLQ means *not letter quality.*) I'm impressed, however, with the NX-1000C and its four internal fonts.

The NX-1000C is Commodore-ready. You don't need a separate interface to connect it to your computer. It's fully compatible with the 64 and the 128, and it prints all the Commodore graphics and business character sets. The 1000C also has an ASCII operating mode which prints the standard ASCII character set.

In draft-quality mode, the nine-pin 1000C prints 144 characters per second (cps) at 12 characters per inch (cpi). In NLQ mode, it slows down to 36 cps, employing a dense matrix of up to 18 × 23 dots to print well-defined characters. The 1000C has four built-in NLQ type styles.

Turn on the printer and it defaults to draft mode. Press a switch on the front of the panel to select one of the NLQ type styles: Courier, Sanserif, Orator with small capital letters, or Italics for all styles. Orator with lowercase letters can be selected by printer control commands. Some 24-pin printers offer a variety of fonts via plug-in cartridges, but to the best of my knowledge, the 1000C is the only nine-pin printer that has fonts built in.

Another switch on the front panel selects the print pitch—the spacing between the letters. The printer powers up in pica pitch, which prints 10 characters per inch. Elite is 12 cpi, condensed pica is 17 cpi, and condensed elite prints 20 cpi. Proportional pica and proportional elite can also be selected. Load a word processor file or spreadsheet and then select the print quality and number of characters per inch prior to printing.

Should you wish to change styles within a document, all of the type styles and pitches can be selected by printer control commands that you include in your document. Orator, for example, is a dot taller than the other styles. You may want to use it for a title or a subheading. Power up in Courier or Sanserif and then switch to any other font or pitch by using an embedded printer command. You also have the option to lock in a desired font to prevent software interference from your word processor.

Like many printers, the 1000C handles both single sheets and fanfold paper, but it utilizes a unique *paper parking* feature that I particularly like. I use a cheaper grade of fanfold paper for everyday printing needs, but I prefer quality stationery for important letters. On most printers, you have to remove the fanfold paper to print a single sheet. Then you have to reload the fanfold, making certain the sprockets are aligned in the tractor drive and that the paper is feeding properly before you can start printing again.

You don't have this hassle with the 1000C. Simply press two switches on the front panel, and the fanfold paper feeds backward out of the way. The printer is now ready to print single sheets. When you've finished with the single sheets and want to reload the fanfold paper, move the bail lever forward, and the paper automatically feeds back into position.

```
This is a sample of Draft quality.
This is a sample of Courier.
This is a sample of Sanserif.
THIS IS A SAMPLE OF ORATOR WITH SMALL CAPITALS.
This is a sample of Orator with Lower Case.
This is Sanserif in Proportional Elite Italic.
```

Print samples from the NX 1000C.

Printing single sheets is also a breeze with the printer's semiautomatic loading feature. Place a sheet into the paper guide and slide it down as far as it will go. Move the bail lever forward, and the paper feeds automatically. Close the bail, and you're ready to print.

The 90-page manual is clear and easy to read. It has an index to help you find specific information quickly. A handy reference card shows DIP switch settings and all the functions of the front panel switches. It also lists about 100 control codes and the page numbers where they're explained in the manual. A chapter on BASIC programming explains how to create special printing effects, how to download custom characters, and how to access the printer's special control commands.

In addition to their normal functions, the four switches on the front panel also perform special applications, including hex dumps, margin adjustments, self tests, and forward and reverse paper adjustments. If you need international character sets, they're accessible at the toss of a DIP switch for Germany, Denmark, France, Spain, Sweden, and Italy.

I use COMPUTE!'s *SpeedScript* word processor, and, in most instances, the 1000C works fine with it. *SpeedScript*, however, uses a code for underlining that the 1000C doesn't recognize. Be sure to remove any *SpeedScript* underline commands, or the printout will be ruined. If you need to underline, you can define your own printkeys with the proper codes without too much difficulty.

The computer did lock up after printing single sheets, but it cleared as soon as I turned the printer off. This same lockup occurred after printing a *GEOS* file. Since the lockups occurred only when the printing was completed, the problem was a minor annoyance. Other than that, the printer worked fine, printing *GEOS* graphics and text in a variety of fonts. (My version of *GEOS* doesn't have a driver for the 1000C, but the NX-10C driver does the job.)

The only other complaint I have is the three-foot cable that connects the printer to the disk drive. I would have appreciated one a little longer.

The printer comes with a one-year warranty. If you have a technical question, free help is available by calling Star's technical support services.

If you're looking for a good, Commodore-ready printer to fit a modest budget, I wouldn't hesitate to recommend the Star NX-1000C. It may be a budget-priced printer, but it certainly doesn't act like one. It'll turn out graphic masterpieces you can hang on the refrigerator door with pride, and you won't be ashamed of the way it prints your résumé either.

—*Tom Netsel*

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2400's are great (but quite expensive). Most users can't justify the cost difference unless they do a large amount of modem work with a service that can handle 2400 baud.

You will also notice a few very cheap 1200s on the market at "too good to be true prices." They are. The reason is that they are usually foreign built and not truly Hayes® and Commodore 1670® compatible therefore not usable in all situations and with all serivces.

What is Hayes® compatibility? It's the industry standard and about all modem manufacturers have adopted the "AT" (Hayes) command set. Virtually all software being written now uses Hayes commands. Beware of those who don't.

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DTR Signal Support?	Yes	No	Yes
High Speed Detect Line?	Yes	No	No
Number of DIP Switches	8	3	8
Number of Status Registers	16	3	?
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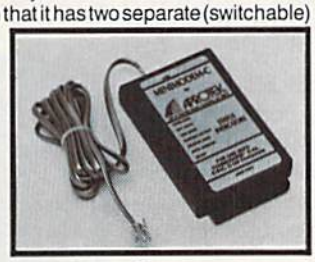

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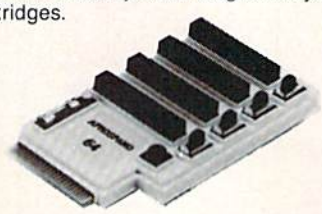

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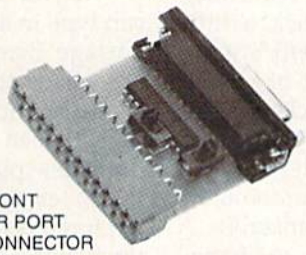

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BB Barrage

William Chin

Drive a hockey puck toward your opponent's goal with BBs shot from a rapid-fire gun. Challenge a friend at this maddening and addictive action game for the 64. Two joysticks are required.

Reload your gun! Your opponent has knocked the puck nearly into your goal. Without some quick work, you'll lose the game.

"BB Barrage" is easy to learn: You just aim at the puck and shoot. Each BB pushes the puck a little closer to your opponent's goal. There is a complication, of course. BBs bounce off the obstacles that inhabit the playfield. After a BB bounces off a few obstacles, it might just knock the puck toward you.

BB Barrage is customizable. A screen editor allows you to change the obstacles, friction, and other game options. After building your ideal version, you can save it to disk for later play.

Typing It In

BB Barrage consists of two programs. The first is the main game program. It's written in machine language. To enter it, use "MLX," the machine language entry program found elsewhere in this issue. When MLX prompts you for starting and ending addresses, respond with the following values:

Starting address: C000
Ending address: CB1F

Carefully enter the data for Program 1. When you've finished typing, save the program to tape or disk. It's important to use the name BB when you save the program since Program 2 tries to load the file by that name.

If you have a disk drive, you can type in and use Program 2, "BB Barrage Screen Editor." This program is written in BASIC. Carefully type it in and save it to disk. BB Barrage Screen Editor allows you to draw new playfields for BB Barrage. It also lets you change certain game parameters, including the friction of the playing surface and the number of BBs. If you have a tape drive, you cannot use the BB Barrage Screen Editor.

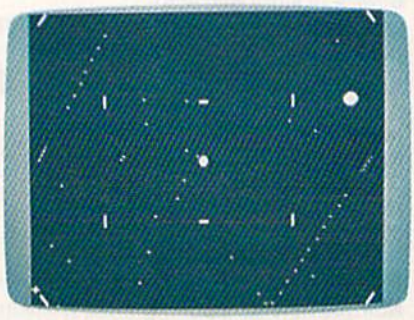
Program 3 is a sample screen for BB Barrage. It's useful only if you also type in Program 2. Using MLX, type in the program and save it to disk. When MLX prompts you, use these values:

Starting address: CB02
Ending address: CBE1

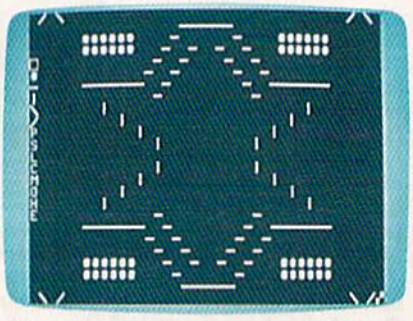
Be sure to save a copy before exiting MLX.

Man Your Stations

To play BB Barrage, plug two joysticks into your computer. Type LOAD"BB",8,1 (or LOAD"BB",1,1 for tape users) and press RETURN.



The left player has pushed the blue puck nearly far enough to score in "BB Barrage."



BB Barrage's editor can be used to create custom screens like this one.

After the program loads, type SYS 49152.

In the center of the screen is a light blue puck. The player whose joystick is in port 1 controls the right side of the field, while the other player controls the left. The goals run along the left and right edges. Your gun is located in the center of your goal. To aim, press the joystick

forward or pull it back. To shoot, press the fire button. Holding the button down enables rapid fire.

The goal of the game is to knock the puck into your opponent's goal. Do this by spraying a stream of BBs toward the puck. Seven goals are needed to win the game.

Note that there are obstacles—known as *deflectors*—on the screen. Although the puck slides right over these deflectors, BBs bounce off them. Careful use of these deflectors can give you the edge you need to win the game.

If a minute passes without a score being made, the screen border turns red, and you go into destruct mode. From now on, BBs destroy the deflectors instead of bouncing off them.

Designing Custom Games

BB Barrage Screen Editor (Program 2) is used to create custom versions of BB Barrage. Before you run Screen Editor, be sure that a copy of BB Barrage is on the same disk (it should be named BB). To use Screen Editor, load and run the program.

The edit cursor is the small yellow block found in the upper left corner of the screen. You can move the cursor with the joystick plugged into port 2. Press the fire button to choose a command. Alternatively, you can simply press the key which corresponds to the command you want. The first five commands allow you to place various types of deflectors on the screen. Besides the deflector commands, the following commands can also be used:

Command	Action
P	Play the game with the current settings
S	Save a screen to disk
L	Load a screen from disk
C	Clear the screen of any barriers
M	Toggle symmetry mode
O	Choose options
H	Show help screen
E	Exit the program

If you choose a deflector, you can use the joystick to move it to various parts of the screen. Press the fire button to place a deflector. If you press again, the deflector is removed.

You can also use the keyboard to place deflectors. To place a deflector, move your cursor to the desired screen position and press SHIFT-Q, SHIFT-* (asterisk), SHIFT-− (minus), SHIFT-N, or SHIFT-M. SHIFT-Q is round. It deflects the BBs randomly. The other four deflectors are straight lines off which the BBs bounce.

A Well-Balanced Screen

The Mirror command (M) creates symmetrical screens. When mirror mode is on, any deflector placed on the screen is mirrored on the screen's three other quadrants. This makes the process of screen design quicker and easier.

The Option command (O) lets you change many important parameters of BB Barrage. First, you can choose colors for the background, border, puck, BBs, and guns. Next, you're asked for the number of goals needed to win the game. You're also prompted for the length of time (in seconds) before the game enters destruct mode (enter −1 to completely disable destruct mode). Next, choose whether you want friction to be on or off. If friction is on, the puck gradually slows down after it's hit. With friction off, the puck keeps sliding until it's hit again. The next option lets you select whether or not players take BBs from a common pool. If you select 1 Possession, BBs that go off your side of the screen cannot be used by your opponent. This option puts more strategy into the game. The number of BBs in play is also variable. The default number of BBs is 100. Just remember that as the number of BBs on the screen rises, the speed of the game decreases. The final question you're asked is whether you'd like to save a custom version of BB Barrage. If you respond by pressing Y, you'll be asked for the filename of the new program. The new version of the game can be played just like the original. Just type LOAD"*filename*",8,1 and type SYS 49152.

There are two disk commands: L and S. The Load command (L) lets you load a screen that you created earlier. You can use this command to load Program 3. The Save command (S) saves a screen design to disk.

The Help command (H) displays a help screen which lists the commands and describes their uses.

The Exit command (E) simply exits to BASIC.

See program listings on page 76.

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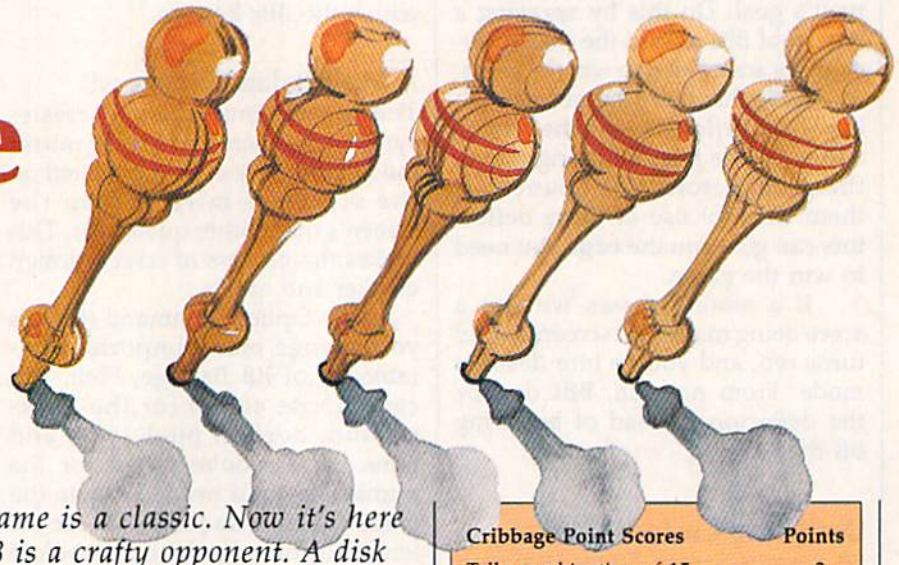
Cribbage 128



Bruce Boyles

This venerable card-and-board game is a classic. Now it's here in electronic form—and your 128 is a crafty opponent. A disk drive is required.

"Cribbage 128" is a computer version of one of the oldest known card games. The computer takes care of the hard part—the scoring. You concentrate on the game to try to beat the computer opponent.

If you are unfamiliar with the rules of Cribbage, see the accompanying article, "Cribbage: A Closer Look."

Typing It In

Cribbage 128 is written partly in BASIC and partly in machine language.

Use "128 MLX," the machine language entry program found elsewhere in this issue, to enter the program. When you're asked for the starting and ending addresses, respond with the following values:

Starting address: 1300
Ending address: 179F

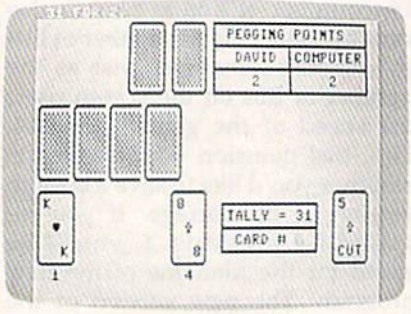
Type in the data for Program 1. When you've finished typing, be sure to save the program to disk with the name CR128. The BASIC program expects to find a file of this name when it is run.

Now type in Program 2, the BASIC portion of Cribbage 128. When you've finished typing, save the program to disk.

Your First Game

When you're ready to play a game of Cribbage, simply type RUN *"filename"*. Use the filename that you used when you saved Program 2.

Cards are designated by numbers. You must discard two cards at the beginning of each hand. Press the numbers corresponding to the cards. If you're not sure what to discard, you can ask the computer for help by pressing H or the HELP key. The computer will offer its suggestions.



Out-think a computer opponent in this computer version of a classic game.

After you discard, pegging begins. The points scored during pegging are displayed in the upper right corner of the screen. The tally is also displayed. When it's your turn, the computer displays the prompt *CARD #*. Press the number of the card that you wish to play.

After pegging is over, the computer shows the hands and their scores. The computer also shows match points, games won, and a breakdown of how the points were scored: from the hand, from the crib, or from pegging.

When either you or the computer scores at least 121 points, the game ends. The computers then asks if you'd like to play again. Press Y for yes or N for no.

You'll find that the computer plays a very good game. The computer isn't terribly cunning, but it's very thorough. It should provide a challenge to even expert players.

See program listings on page 70.

Cribbage Point Scores	Points
Tally combination of 15 (10, 2, 1, 2)	2
Tally total of 31 (during pegging only)	2
Last card pegged (one for the go)	1
Cut card is a jack (two for his heels)	2
Jack same suit as cut card (one for his nob)	1
One pair (2, 2, 5, 7)	2
Three of a kind (2, 2, 2, 5)	6
Four of a kind (2, 2, 2, 2)	12
Run of three cards or more (5, 6, 7, 8)	1 per card
Double three-card run (3, 4, 5, 3)	8
Double four-card run (4, 4, 5, 6) cut 7	10
Triple run (4, 4, 5, 6) cut 4	15
Quadruple run (8, 8, 9, 9) cut 10	16
Flush (four cards)	4
Flush (five cards)	5

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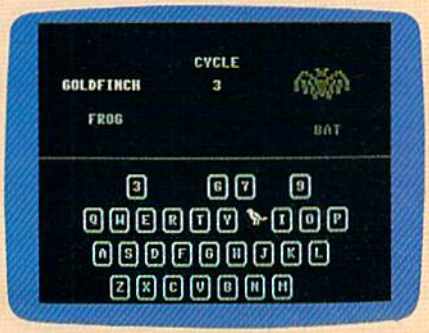

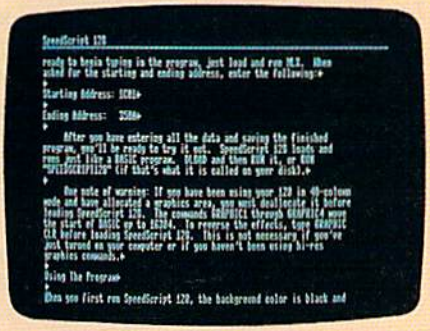

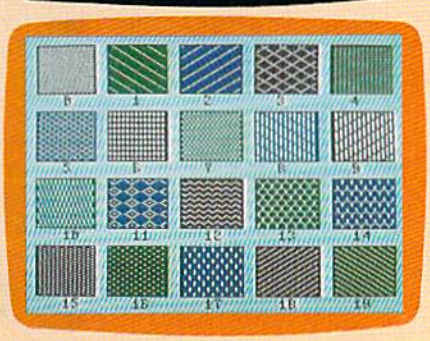

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Cribbage: A Closer Look

Cribbage is the oldest of all two-handed card games. In fact, it's among the oldest of *all* card games. Historically, its invention dates back to the early 1600s and is most often associated with the English poet Sir John Suckling.

Cribbage is a two-player game. It's played on a table or large open space with a standard 52-card deck and a Cribbage board. The board (a wooden board with peg holes) is used to keep score.

The reason that pegs are so useful in scoring is that there are so many different opportunities to score during play. The pegs are advanced appropriately when a score is made. The first player to reach the end of the board is the winner. The computer version of Cribbage conveniently replaces the need for a partner, table, cards, and Cribbage board.

The Rules of Cribbage

The object of the game is to be the first player to obtain a total point score of 121 or more. The cards rank from the high card (a king) down to the low card (an ace). All cards are counted at face value. Face cards are valued at ten. Aces are worth one point.

At the beginning of a game, the computer cuts the cards to determine who deals first (low card deals). The dealer shuffles and then deals six cards to each player (the opponent receives the first card). In the computer version of the game, your cards are located at the bottom portion of the screen and your opponent's cards are at the top.

After the deal, the remaining cards are put away until needed. Both players then select two of their six cards to discard. These four discards are known as the *crib*. The crib is scored as an extra hand contributing to the dealer's total at the end of a game. It is located in the center of the screen between the players' hands. Whenever both players have discarded two cards in the crib, it's removed until the end of the game.

When the crib has been put away, the dealer cuts the remaining cards in the deck. The bottom card from the cut is placed face up in the lower right portion of the screen. If the cut card is a jack, the dealer pegs (scores) two points. This is referred to as *two for his heels* in Cribbage jargon. The cut card counts as the fifth card for both players hands, and it's also the fifth card of the dealer's crib. Other than being involved in scoring, the cut card is not used in the pegging or play portion of the game.

Game Play

Once the cut has been made, play begins. Both players alternate playing the four cards remaining in their hands. This is called *pegging*. The dealer is never the first to play. Once a card is selected, it's placed in the center row on the screen. The total of the cards is displayed in the tally box. Play continues until the total of the cards is 31 or as near to 31 as possible.

If, during his or her turn, a player cannot play a card without exceeding 31, the turn is passed to the other player. The opponent must play any or all of his or her cards until 31 has been reached or until no further plays can be made. If neither player can play a card without exceeding 31, then the last player able to play receives one point for closing. This is commonly referred to as the *go*. If your cards total exactly 31, you'll receive two points for the go. Once a final go or 31 has been reached, the cards that have been played are turned face down, and play continues with any remaining cards.

After both opponents have played the cards in their hands, the remaining cards are revealed. This is referred to as the *meld*. The computer displays the dealer's hand last. This allows the dealer's opponent the chance to total 121 or more and win the game even if the dealer may have scored higher. If the opponent's total is less than 121, the dealer's hand is displayed. Finally, the crib (the cards set aside earlier in the game) is displayed along with the point total.

Once the hands are shown, a scoreboard is displayed. This scoreboard contains the following information: total number of hands played, total match points, games won, points in hand, points in crib, points pegged, and total score. These scores can be valuable for evaluating game play.

Scoring

In addition to the points scored for the go and 31, there are several other ways to score when playing Cribbage. Keep in mind that points are scored in pegging and also in the meld.

Two points may be earned whenever the sum of the face value of the cards played equals 15. For example, if the first player plays a 7 and the second player plays a 5, then the first player could play a 3 and would receive two points for making the tally equal 15.

Every pair (two cards of the same denomination played in succession) scores two points. Three of a kind scores 6 points, and four of a kind scores 12 points.

Points are awarded for *runs*. A run is similar to a straight in poker. The minimum number of cards in a run is three. The cards in a run do not necessarily have to be played in numerical order. However, they do have to be grouped together. For example, the following are all legitimate runs: 6-7-8, 8-6-7, 7-8-6. Remember, the ace is low in Cribbage, therefore ace-king-queen is not considered a run. One point is scored for each card in a run.

In the meld, it's possible to have double and triple runs. For example, 3-3-4-5 would be a double three-card run (using the 4 and 5 with each 3), and 3-3-4-5-6 would be a double four-card run.

If all four cards in the hand are of the same suit, then four points are counted for a flush. If the cut card is of the same suit, then five points are scored. In the crib, all five cards must be the same suit in order to score points for a flush.

If your hand contains a jack with the same suit as the cut card, you receive one point. This is referred to by Cribbage players as *one for his nobs*.

—David L. Hensley, Jr.

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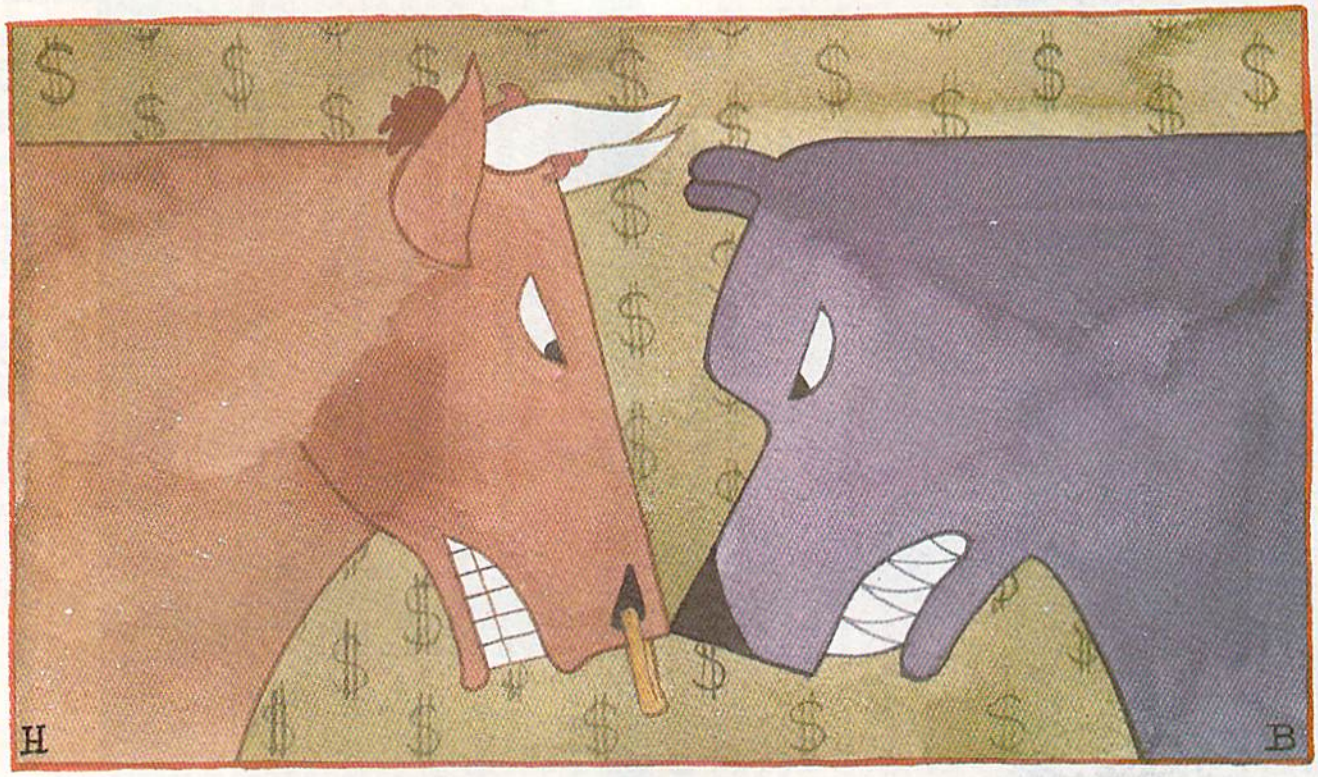

Investor

Troy Tucker

Buy! Sell! Buy! Buy! Ride the stock market to fortune in this one- or two-player simulation of mutual-fund investing. It's both educational and fun. For the 64, 128, Plus/4, and 16.

You've just inherited a thousand bucks. Should you invest in art? Maybe precious metals is your game. Or maybe you like things closer to home—coins, stamps, and baseball cards. After considering several investment options, you pick the stock market—and we all know the risk that involves. So, to minimize your chances of getting burned on individual stocks, you make mutual funds your investment vehicle.

Mutual funds buy and sell groups of stocks. For instance, when you buy a share of the Computers fund, you're really buying shares of IBM, Commodore, Cray Research, Control Data, Apple, and dozens of other related companies that make up this fund. You're betting that the computer industry as a whole will increase in value.

"Investor" lets you (and, optionally, a friend) invest in a simulated market of mutual funds. If you're observant (and lucky) you'll take home a million bucks. But if you're not careful, you'll lose your shirt.

Typing It In

Investor is written entirely in BASIC. One version works on all of the following computers: the Commodore 64, 128, Plus/4, and 16. Type in the program and save it to disk or tape. If you plan on using the program in 128 mode, be sure to enter it in that mode.

To start the game, load the program and type RUN. You'll be asked for the number of players who wish to play. Enter 1 or 2. Next, enter names for the players. Finally, decide whether you want to play a short, medium, or long game. A short game averages about 15 minutes, a medium game lasts about 30, and a long one is about 45.

The game begins. Each player starts with $1,000. You'll see the main screen. Eleven different mutual funds are offered, and five columns of numbers display important information about each fund.

FUNDS COST AT HI LOW DIV
LEISURE 96 -4 104 85
AEROSPACE 106 6 114 100
GOLD 102 2 109 86
ENERGY 109 9 112 97
AGRICULTURE 99 -1 103 93
TECHNOLOGY 104 4 104 86
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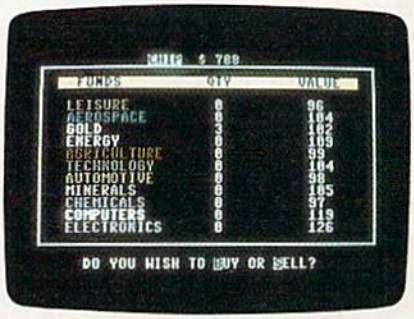

Manage your personal portfolio. This player owns three shares of gold.

The first two columns relate to the current price of the fund. The

first value is the actual cost for each share of the fund. This is the amount you'll pay if you decide to buy into that fund. The second number shows the change in the fund price since the beginning of the game.

The third and fourth columns respectively show the record high and low prices of the fund since trading began.

The final column shows dividends. When stocks issue dividends, owners of the stocks receive a certain amount of money per share of stock. In Investor, dividends are distributed to the owners of funds as a percentage of the current price of the fund. When the fund is doing well (at or above $100 per share), the dividends range from 1–5 percent. When the fund is doing poorly, the dividends are fixed at ½ percent.

The Smart Trader

Watch the big board. When you decide that you want to buy a fund, press the space bar. Enter your name, and you'll see your portfolio. You'll be asked whether you want to buy or sell. Then you'll be asked what fund you would like to trade. Enter the name of the fund. If you're buying, Investor will tell you how many shares you can purchase. Enter the number of shares of that fund that you would like to sell or purchase. Your portfolio will be updated.

Keep a close eye on the funds you own. If a fund goes down near 0, sell! A fund goes under when it hits 0—everyone holding the fund loses all their shares, and the fund's price is reset to $100.

A fund can also go through the roof. At $200, the fund "splits" 2 for 1. The price of the fund is halved to $100, and you're awarded twice as many shares.

The Closing Bell

When the clock at the top of the screen winds down to 0, the market closes and the final statistics are displayed. Look at your total net worth. If you end with a total higher than $1,000, consider yourself a budding financial genius. If you end up with less, you'll have another chance another time to step out onto the trading floor and make your million.

See program listing on page 69.

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Computers' Conversations

Rhett Anderson
Assistant Editor

Computers talk. Ask anybody.

It's easy on *Star Trek*. "Computer," Captain Kirk might say, "cross reference the Klingon flight pattern with the dance of the Earth worker bee."

"Working . . .," the computer says. And then, "Completed."

"Estimate the next time that the Klingons will pass in front of us."

"Working. . . . Five minutes, 28 seconds."

"Scotty, I need full power in five minutes."

Jim Kirk makes it sound easy. He just talks to the computer like it's a human being.

In *War Games* it's more difficult. Matthew Broderick has to type his questions into a computer. The computer talks back, once it's connected to a speech synthesizer. Of course, by the end of the movie, it's speaking *without* a speech synthesizer, but that's Hollywood for you.

Making It Talk

One of this month's features, "Talk Is Cheaper," discusses several products on the market that can let your Commodore 64 talk. To understand how this is fundamentally possible, we need to turn the clock back and look at the first inventions that talked—Alexander Graham Bell's telephone, Marconi's radio, and Edison's phonograph.

Sound travels through the air to our ears. In the telephone, a microphone translates the waves that pass through the air into electricity. The electrons travel through a wire and into a speaker. The speaker translates the electric pulses back into sound by physically moving the air.

In the radio, another step occurs: The electricity is translated by the radio transmitter into another sort of wave—a radio wave. The receiving radio (or radios) translates the radio waves back to electricity, then back into audio waves.

In the phonograph, the strength of the air waves presses a needle into wax. This recording can then be played back—the recording moves a needle, and the movement is translated into sound.

In a more modern device, the CD (Compact Disc) player, the sound waves are turned into electrical impulses, then are translated into numerical quantities; the louder the sound, the bigger the number. At the factory, these numbers are pressed into discs. When you play a CD on a player, the numbers are read with a laser, turned into electrical pulses, and then sent to your speakers to produce sound.

Computers produce sound in much the same way as a CD player: Numbers in your computer's memory are sent to the sound chip and then into your monitor's speaker. Any sound can be captured (digitized) and played back with this method. In fact, a whole sentence can be digitized for playback. Alternatively, *phonemes* (the building blocks of speech) can be digitized and then strung together to create any phrase.

Making It Listen

A few years ago on *Computer Chronicles*, a weekly computer news show on PBS, co-host Stewart Cheifet was trying out a young entreprenuer's computer. On the screen was an adventure game. A headset on Mr. Cheifet's head let him control his onscreen alter ego.

Mr. Cheifet tried to tell the character what to do. But it didn't understand him. It just kept asking "What, what, what?" After a few tries, Mr. Cheifet gave up. He turned to ask the flustered young man about the computer. Unfortunately, he didn't take the headset off. As the two men talked, the computer in the background kept asking "What, what, what?"—much to the inventor's distress.

What happened? As difficult as it is to make a computer talk, it's even more difficult to make a computer understand speech. Say the word *ten* ten times. It may sound the same to you each time you say it, but there are subtle differences. If a computer's listening, each and every *ten* sounds unique.

To teach a computer how to understand a word, you have to "train" it. You say the same word, over and over, into the computer's microphone. It listens, and as it listens it builds a set of numbers that represent the word. Later, when you say the word again, it checks the word against its composite definitions of all the words it knows.

The Future

Computer scientists are working on many fronts to create computers that can hold a conversation with you. Perhaps the biggest problem is this: How do you make a computer understand what you're talking *about*? Some of the most cherished of all computer science legends revolve around this problem.

In one, a computer that's programmed to sift through newspaper stories for terrorist actions gets bogged down in the sports section—"Giants Kill Rams," "Bulldogs Massacre Tigers." It then tries to interpret its findings.

In another, a computer translates text from English to Russian and back. In its most spectacular faux pas, it changes "The spirit is willing, but the flesh is weak" to "The vodka is strong, but the meat is rotten."

But progress *is* being made. Before we know it, the day of the talking computer will be upon us.

simple answers to common questions

Tom R. Halfhill

Q. On occasion, last summer, I noticed a bit of funky activity with disk operations on my 1541. I took the drive apart just to see if it contained so many chips that it would be hopeless for me to attempt to repair it myself. I poked around for a while, noting how heavily built the drive appears to be. While the drive was still apart, I tried it out once more. Lo and behold, it worked fine.

The evidence points to an overheating problem. Do I have a drive with a chip so close to going over the edge that a little heat makes it go bonkers? Or do 1541s in general need lots of fresh air to work properly? The air temperature in the room was 80 degrees. I have weighed the pros and cons of putting a fan on the drive. The drive would stay cooler, but more dust would be blown in. Just how much cooling does a 1541 need?

A. You've hit upon a very common problem that often leaves people baffled. If mysterious computer crashes, lockups, and equipment failures seem to happen more frequently in the summer, it can probably be blamed on overheating.

As you may know, large minicomputer systems and mainframes are almost always housed in special rooms in which temperature and humidity are carefully controlled. There's a good reason for this, of course: Few large computers can function in temperatures of 80 degrees Fahrenheit or more.

Years ago, a daily newspaper for which I worked installed its first computerized editing/typesetting system. At the same time, extra air conditioning was installed in the newsroom—but not for the reporters and editors. Instead, the air conditioning was required to keep the newsroom cool enough for the video display terminals (VDTs) to operate. We used to joke about how the computer received better treatment than we did.

Then, one sweltering summer morning, we learned it was no joke. The air conditioning broke down before the first-edition deadline, and the VDTs started going haywire. To avoid unspeakable disaster (the paper had not missed an edition in about a century), people were dispatched all over town to buy bags of dry ice. The bags were packed around the VDTs until the last edition was put to bed.

The overheating problem isn't quite as acute with personal computers, but it still exists. These days, we tend to equate computers with other home appliances that can operate in almost any temperature, even though microprocessors and memory chips are much more sensitive to heat than the simple switches, motors, transformers, and amplifiers that make up other consumer electronics devices.

Your 1541 probably started working again when you removed the cover because the topless housing allowed more heat to escape. So why doesn't the drive have more ventilation? Because when engineers design home computers and peripherals, they have to compromise between efficient cooling and adequate radio frequency (RF) shielding. Without enough shielding, computing devices may interfere with nearby TV and radio reception. The Federal Communications Commission requires home computing devices to meet RF standards that are even more stringent than those for business computers. Unfortunately, heavy RF shielding leads to overheating problems.

If overheating is indeed your trouble, an add-on fan will almost certainly solve it. First, though, you might try setting up an ordinary household fan to gently waft air over your whole computer system. This might provide adequate cooling and also has the advantage of keeping you cooler, too. Another alternative is to operate your 1541 during the summer months with the top cover removed (unless your neighbors or family members complain about RF interference). Replace the cover between work sessions to keep out dust.

As personal computers grow more and more powerful, and as memory chips grow increasingly dense, it's likely that we'll see more built-in fans. Most home computers have omitted fans up to now because of the added manufacturing costs and the extra noise, which is more obtrusive in a home environment than in a busy office.

Q. Is it possible to interface an Atari 825 printer to a Commodore 64? I've been told the 825 is actually a Centronics 737 printer, and it should be possible. What kind of interface can handle hi-res screen printouts as well as word processing chores?

A. The Atari 825, first introduced about eight years ago for the old Atari 400/800 computers, is indeed a Centronics printer in disguise. It therefore works with a Centronics-standard parallel interface. These interfaces are available for the Commodore 64; check with your local Commodore dealer.

Graphics screen dumps and text output shouldn't be a problem; in fact, the Atari 825 supports proportionally spaced printing, if your word processor allows you to access such special features. However, remember that the Atari printer won't support the special Commodore character set.

BASIC for beginners

Rounding

Larry Cotton

This month we'll learn how to round numbers in BASIC.

There are many reasons for rounding off numbers. If you want to split a dollar bill with two friends, you can't give each of them 33.33333... cents—you give them each 33 cents, and keep 34 cents for yourself.

Another reason to round off numbers is to produce a neater display. Sometimes we want a number to fit into a certain field on the screen. If a mathematical calculation produces a number such as 34.36437, for example, we can round it to any lesser degree of accuracy we wish.

If we want to round a number to two decimal places, we look at the digit in the third place to the right of the decimal point (in this case, it's a 4). We then compare it to 5. If it's equal to or greater than 5, the digit to its left (in this case, 6) is increased by 1. If the examined digit is less than 5, the number to its left is not changed. Thus, 34.36437 rounded to two decimal places is 34.36.

If we want to round to one decimal place, we look at the second digit to the right of the decimal—in this case, a 6. Comparing it to 5 and finding that it's greater, we increase the number to the left of the 6 (3) by 1. Therefore, 34.36437 rounded to one decimal place is 34.4.

Rounding in BASIC

In BASIC, the general rounding formula uses two operations we've covered recently—finding the integer value of a number (INT) and raising a number to a power (multiplying a number by itself):

```
R=INT(N*10^D+.5)/10^D
```

R is the rounded number that you seek, N is the number to round, and D is the number of decimal places you wish.

Let's write a short rounding program which asks the user to enter numbers to round:

```
10 PRINT"{CLR}"
20 PRINT:PRINT" WHAT NUMBER DO
   YOU WANT TO ROUND?"
30 PRINT:INPUT" ";N
40 PRINT:INPUT" TO HOW MANY
   DECIMAL PLACES?";D
50 R=INT(N*10^D+.5)/10^D
60 PRINT:PRINTR
70 PRINT:PRINT" ANOTHER NUMBER
   (Y/N)?"
80 GETA$:IF A$<>"Y") AND (A$<>"N")
   THEN 80
90 IF A$= "Y" THEN RUN
```

Run the program and enter 453.567552 at the first prompt and 3 at the second. Below is a description of how it works.

Line 10 clears the screen. Lines 20 and 30 print a blank line and ask the user to type in a number. When he or she enters 453.567552 and presses RETURN, the INPUT statement assigns that value to N.

Line 40 gets the number of places to which you wish to round the number. The 3 that we entered becomes the value for D.

Line 50 is the heart of our program; it calculates a value for R using the formula mentioned above:

```
R=INT(N*10^D+.5)/10^D
```

Let's take a closer look. Recall the order of math operations that we've covered over the last couple of months:

1. Parentheses
2. Raising a number to a power (multiplying a number by itself)
3. Multiplication and division
4. Addition and subtraction

Our rounding formula will be executed in the above order, so let's attack the parentheses first:

```
(N*10^D+.5)
```

Within the parentheses, the 10 will be raised to the power of D (10 will be multiplied by itself D times). Since the value for D is 3, 10 will be multiplied by itself three times; it becomes 10 times 10 times 10, or 1000.

After that, the multiplication within the parentheses takes place. Let's multiply N (453.567552) by 1000. The easiest way to do that is to move the decimal in a direction that will make the number 1000 times larger (that's to the right three places). The result is 453567.552.

We're still inside the parentheses. Add .5 to 453567.552 to get 453568.052. Now take the INT of that number. Remember that INT simply drops all decimal places to leave a whole number. The result is 453568.

What's next? Dividing by 10? Or dividing by 10^D? Remember: powers before multiplication. Raise 10 to the third power again to get 1000. Now the formula is reduced to

```
R=453568/1000
```

Finally we divide to get an answer of 453.568, which should have been the result of running the program and entering the two suggested values. Line 60 prints the answer.

Line 70 asks the user if he or she wants to round other numbers. Line 80 waits patiently for either Y or N (Yes or No) to be typed. If Y is typed, line 90 is executed and the program runs from the beginning. If N is typed, the program ends (an END statement isn't necessary).

Try entering various numbers to round and different numbers of places to which they should be rounded. If you type a value for D greater than the number of decimal places, you may get an overflow error.

Rounding vs. the INT Function

Please don't confuse rounding a number with finding its integer value. Finding a number's integer value always just drops the digits after the decimal, leaving a whole number. Rounding can be done for any number of decimal places. While the INT function always produces a number less than or equal to the original number, rounding in-

creases the number half the time and decreases it the other half.

Let's take the number 10.583. Rounded to one decimal place, the number is 10.6. To zero decimal places, the number is 11. The integer value of 10.583 is 10.

Uses for Rounding

Let's discuss money. In America we usually round to two places (hundredths of a dollar, or cents), so we can specialize our rounding formula. Start with

```
R=INT(N*10^D+.5)/10^D
```

And substitute 2 (two decimal places) for D:

```
R=INT(N*10^2+.5)/10^2
```

Raising 10 to the second power, or squaring 10, yields

```
R=INT(N*100+.5)/100
```

It's a temptation, but we *cannot* add 100 and .5 to get R=INT (N*100.5)/100 because that would violate the correct hierarchy of operations—N must be multiplied by 100 before we add .5.

Since 100 appears twice in the formula, we can assign a variable name to it first. Let's use H (for Hundred):

```
H=100:R=INT(N*H+.5)/H
```

Here's a program that will compute the average price (to the nearest cent) we pay for something when we buy a certain quantity. We'll use our specialized rounding formula:

```
10 PRINT"{CLR}"
20 INPUT" HOW MANY WILL YOU BUY";Z
30 PRINT" PRICE FOR"Z"{LEFT}?"
40 PRINT:INPUT" ";P
50 N=P/Z:REM ACCURATE PIECE PRICE
60 H=100:R=INT(N*H+.5)/H:REM THIS IS OUR
   SPECIALIZED ROUNDING FORMULA
70 PRINT:PRINT" AVG. PRICE EA. ="R
80 PRINT:PRINT"ANOTHER (Y/N)?"
90 GETA$:IF (A$<>"Y") AND (A$<>"N") THEN 90
100 IF A$="Y" THEN RUN
```

Game Scoring

Another common use for rounding is in scoring games. We can create a specialized formula that uses 0 as the value for D, since we want our result rounded to a whole number, with no decimal places.

We start with our general formula:

```
R=INT(N*10^D+.5)/10^D
```

And substitute 0 for D:

```
R=INT(N*10^0+.5)/10^0
```

This yields an interesting result based on a strange mathematical rule: Anything raised to the power of 0 is 1. Thus, X to the power of 0 is 1, 14 to the power of 0 is 1—even 1254678 to the power of 0 is 1. Try a few in immediate mode:

```
PRINTX^0
PRINT14^0
PRINT1254678^0
```

Accordingly, 10 to the power of 0 is 1:

```
R=INT(N*1+.5)/1 or R=INT(N+.5)
```

Voilà! A new formula for rounding to whole numbers. Let's write a short program to calculate average shots per hole in three rounds of golf:

```
10 PRINT"{CLR}"
20 INPUT" FIRST ROUND";R1
30 IF R1<>INT(R1) THEN GOSUB200:GOTO20
40 Z=R1:GOSUB300
50 INPUT" SECOND ROUND";R2
60 IF R2<>INT(R2) THEN GOSUB200:GOTO50
70 Z=R2:GOSUB300
80 INPUT" THIRD ROUND";R3
90 IF R3<>INT(R3) THEN GOSUB200:GOTO80
100 Z=R3:GOSUB300
110 TS=R1+R2+R3:PRINT" TOTAL SHOTS FOR 3
    ROUNDS:"TS
120 N=TS/54:REM 54 HOLES IN 3 ROUNDS
130 R=INT(N+.5):REM SPECIALIZED ROUNDING
    FORMULA
140 PRINT:PRINT" AVG. SHOTS PER HOLE FOR 3
    ROUNDS:"R
150 END
200 PRINT:PRINT" NO DECIMALS, PLEASE!"
210 PRINT:RETURN
300 N=Z/18:REM 18 HOLES PER ROUND
310 R=INT(N+.5):REM SPECIALIZED ROUNDING
    FORMULA
320 PRINT:PRINT" AVG. SHOTS PER HOLE:"R
330 PRINT:RETURN
```

Golf scores don't contain fractional values, so lines 30, 60, and 90 check for this by comparing the INPUT numbers with their integer values. If they're not the same, a decimal value must have been entered and the questions are repeated.

Lines 40, 70, and 100 make Z equal to R1, R2, and R3 in succession, so one subroutine at lines 300–330 (to calculate average shots per hole) can be used repeatedly.

The rounding formula, custom-tailored for whole numbers, is used in line 310 to round scores to values which contain no decimals.

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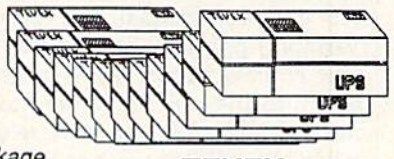

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machine language programming

Pointer Loops

Jim Butterfield
Contributing Editor

Pointers are important in machine language programming. A pointer (sometimes called a *vector*) is a two-byte number that holds an address. It points to something—a string, an item in a table, or some other sort of data. It can even point to another pointer.

Machine language programmers often use pointers as loop controls. Before the loop, the pointer is set up to point to a certain address, often the start of a table in memory. As the loop repeats, the pointer is moved along to succeeding entries in the table. Of course, the pointer is regularly tested to see if it has gone beyond a preset limit.

System Pointers

Two examples specific to the Commodore 64 will illustrate the usefulness of pointers. First, to go through screen memory, we would initialize the pointer to the address of the start of the screen: that's $0400 (1024 decimal). To go to the next line, we would add $28 (40 decimal) to the pointer. We could count 25 lines or we could test to see when the pointer exceeds a value of $7C0 (1984 decimal), the address of the last line in screen memory.

Here's another example. To look through BASIC's variables, we would set the pointer to match the contents of addresses $2D and $2E (45 and 46 decimal, the Start of Variables pointer). Since each variable entry occupies seven bytes, we add 7 to the pointer to step to the next variable. We know we're done when the pointer reaches the value contained in another pointer found at addresses $2F and $30 (47 and 48 decimal, the End of Variables/Start of Arrays pointer).

As the pointer's value moves from address to address, we will need to access the contents of these addresses. Two of the 6502's addressing modes are perfect for the job. Indirect addressing allows us to reference an address through a pointer. A related mode, indexed indirect addressing, uses the Y register to point to a certain byte offset from an indirect address.

The jargon of addressing modes can be hard to decipher. An example is in order.

Two-Letter Words

The program given here asks the user to input two-letter words. Each time such a word is entered, it's checked against all previously entered words. If a match is found, the program terminates, printing asterisks. If no match is found, the new word is added to a table of previously entered words.

We build the table and check it by means of pointers. One pointer shows the last entry in the table—it's kept at $20F0 (8432 decimal). The other pointer scans through the table, looking for a match; it's at $FD and $FE (253 and 254 decimal) in zero page. There is no limit to how large the table may be.

The program is simple, but it shows how pointers are handled.

Mechanics

Let's take a look at a few critical parts of the program. The pointer at $FD and $FE is set up to scan memory starting at address $2100 (8448 decimal). Here's how we set it up:

```
2035   A9  00   LDA  #$00
2037   A2  21   LDX  #$21
2039   85  FD   STA  $FD
203B   86  FE   STX  $FE
```

We must test the pointer to see if it has gone beyond the table limit, as logged in the pointer at $20F0. A good way to compare two-byte pointers is to compare and subtract:

```
203D   AD  F0  20   LDA  $20F0
2040   C5  FD      CMP  $FD
2042   AD  F1  20   LDA  $20
2045   E5  FE      SBC  $FE
2047   B0  19      BCS  $2062
```

If the carry flag is clear, the pointer at $20F0 is less than the one at $FD. In this case, we've passed the end of the table, so we will update the table by storing the new data. But if the carry flag is set, we continue to search the table. If no match is found, we'll increment the pointer with

```
2073   A5  FD   LDA  $FD
2075   A6  FE   LDX  $FE
2077   18       CLC
2078   69  02   ADC  #$02
207A   90  BD   BCC  $2039
207C   E8       INX
207D   B0  BA   BCS  $2039
```

The BCS above will always branch. We'll store the pointer back into $FD after we get back to $2039.

Try It

This was a simple example, but it gives you a chance to see the three parts of pointer loops: setup, limit test, and incrementing. If you want to try the program, you can type in and run this BASIC loader. If you have a machine language monitor, use it to view the entire machine language program.

```
100 DATA 169,254,162,32,141,240
110 DATA 32,142,241,32,169,63
120 DATA 32,210,255,32,207,255
130 DATA 201,65,144,244,201,91,176
140 DATA 240,141,244,32,32,207,255
150 DATA 201,65,144,230,201,91,176
160 DATA 226,141,245,32,32,207,255
170 DATA 201,13,208,216,32,210,255
180 DATA 169,0,162,33,133,253,134,254
190 DATA 173,240,32,197,253,173,241
195 DATA 32,229,254,176,25,160,0
196 DATA 173,244,32,145,253,173,245
197 DATA 32,200,145,253,165,253,141,240
198 DATA 32,165,254,141,241,32,208,168
199 DATA 160,0,173,244,32,209,253
200 DATA 208,6,200,173,245,32,209,253
210 DATA 240,12,165,253,166,254,24,105
220 DATA 2,144,189,232,176,186,162,0
230 DATA 169,42,32,210,255
240 DATA 232,224,16,208,248,96
300 FOR J=8192 TO 8331
310 READ X
320 T=T+X
330 POKE J,X
340 NEXT J
350 IF T<>22019 THEN STOP
400 REM SYS 8192
```

Boolean Magic on the 64

Vincent D. O'Connor

One of the nicest features of the 128's BASIC 7.0 is the IF-THEN-ELSE statement. If you're unfamiliar with this command, here's an example of how it can be used in a program:

```
HM 100 PRINT "ANSWER (Y/N)";
DA 110 GET A$:IF A$="" THEN GO
       TO 110
QG 120 IF A$="Y" THEN GOTO 140
       :ELSE IF A$="N" THEN G
       OTO 150
XK 130 GOTO 110
GE 140 PRINT "{CLR}YOUR ANSWER
        WAS YES":END
QS 150 PRINT "{CLR}YOUR ANSWER
        WAS NO"
```

The advantage of this command is that you save memory and increase speed by not having to use multiple IF-THEN statements.

Although the 64's BASIC 2.0 doesn't have an IF-THEN-ELSE command, there's a way to simulate it using the ON-GOTO statement and Boolean, or two-valued, logic. Here's how the example program could be written for the 64:

```
HM 100 PRINT "ANSWER (Y/N)";
DA 110 GET A$:IF A$="" THEN GO
       TO 110
BE 120 ON -((A$="Y") + 2*(A$="
       N")) GOTO 140, 150
XK 130 GOTO 110
GE 140 PRINT "{CLR}YOUR ANSWER
        WAS YES":END
QS 150 PRINT "{CLR}YOUR ANSWER
        WAS NO"
```

As you can see, the only change is in line 120, where the use of the ON-GOTO is substituted for the IF-THEN-ELSE used in the first example.

Here's how it works. When BASIC evaluates a comparison, it determines a value based on whether the comparison is true or false. If the comparison is true, BASIC returns −1. If it's false, it returns 0. In the example program, if A$ equals Y, then the expression (A$="Y") is true and is evaluated as −1, while the expression (A$="N") is false and is evaluated as 0.

The rest is simple math. BASIC's order of operations requires that multiplication and division be performed before addition and subtraction, so if the answer is "yes," A$ = "Y" will evaluate to −1 and A$ = "N" will evaluate to 0. Substituting these values in the statement in line 120, we have

−((−1) + 2 * (0))

Since multiplication must be performed before addition, 2 * 0 equals 0, and −1 + 0 equals −1. The initial minus sign causes this −1 to become +1, and the first GOTO is executed, causing a branch to line 140. The opposite would be true if A$ were equal to "N." BASIC would evaluate the expression as

−((0) + 2 * (−1))

Performing the multiplication first, this is further simplified to −(−2), which is +2, causing the second branch following the GOTO to be taken.

BASIC Directory Printer

Joseph R. Charnetski

There are so many situations in BASIC programs that call for a directory listing on the screen. Unfortunately, on the 64, loading a directory erases the program currently in memory. With this handy utility, you can display a directory without altering a byte of your program. And, if you include this short routine in your program as a subroutine, you can instantly access the directory as often as you like.

The routine reads the directory from the disk and prints it on the screen without loading it into the computer's memory. If the directory scrolls off the screen too quickly, press any key to pause or continue. You can also exit the routine at any time by pressing Q (Quit).

```
DM 10 OPEN15,8,15,"I0":OPEN8,8
      ,0,"$"
EE 20 GET#8,A$,B$:N$=CHR$(0)
FG 30 GET#8,A$,B$:IF B$=""THEN
      100
ME 40 GET#8,A$,B$:A=ASC(A$+N$)
      :B=ASC(B$+N$)
KS 50 C$=MID$(STR$(A+256*B),2)
      +CHR$(32)
MF 60 PRINT C$;:GET#8,C$:IFC$<
      >""THEN60
AS 70 PRINT:GETK$:IFK$=""ORK$=
      "Q"THEN90
XB 80 GETK$:IFK$=""THEN80
XQ 90 IFK$<>"Q"THEN30
GA 100 CLOSE8:CLOSE15
```

SHIFT–RUN/STOP Disable for 128

Andrew Beltran

The SHIFT–RUN/STOP key combination loads the first program on the disk in 128 mode. This can be useful and time saving, but it can also cause problems. It's easy to *accidentally* hit the SHIFT–RUN/STOP key combination, causing the first program on the disk to load and your program in memory to be erased.

There are three ways to circumvent this disaster. The first is to simply have the first file on the disk be SEQuential. BASIC won't be able to load and run this file, so your program is safe. Another solution is to leave the disk drive door open while you're programming and close it when it's time to save your work. Neither of these solutions is very appealing, however.

The following one-line program will disable the SHIFT–RUN/STOP key combination and protect you from accidental disaster.

```
1 POKE 4104,0:FOR I=4159 TO 4164:
  POKE I,PEEK(I+9):NEXT
```

One easy way to use this short program is to put it in an autoboot file on the disks you use for programming. That way, the SHIFT–RUN/STOP combination will be disabled when you need protection, and it'll be operative otherwise.

The Tinkertoy, Tic-Tac-Toe-Playing Computer

Fred D'Ignazio
Contributing Editor

At dinner the other night at the New Jersey Computer Conference, I got to hear a vintage hacker story that I'd like to share with you.

Brian Silverman and Margaret Minsky were reminiscing about the fun they used to have as grad students in the mid-1970s, living with a bunch of crazy computer hackers, including Danny Hillis (cofounder of Thinking Machines and designer of the Connection Machine, perhaps the world's fastest supercomputer).

The Conversation

"One day," said Brian, "Danny brought home a bunch of Tinkertoys. Since we were MIT students, we set out to prove you could make logic gates out of the Tinkertoys. We had built several AND gates and OR gates, when someone suggested we try making an entire computer out of Tinkertoys. We worked on that idea for quite a while but finally gave it up. We had decided that we could do it, but a Tinkertoy computer as sophisticated as a Motorola 6502 would have barely fit in the biggest domed stadium in the world.

"The same group," continued Margaret, "went on to found Terrapin (home to robots and Terrapin Logo). Our first project at Terrapin was a cute little robot turtle that just happened to appear at the same time as the first *Star Wars* movie. We got calls from all over the world about our robot, including a call from Harry Loucks, who wanted us to design a robot for his new museum, the Mid-America Center, in Hot Springs, Arkansas. We all remembered the fun we had with the Tinkertoys and asked him if he wanted a Tinkertoy, tic-tac-toe-playing computer instead of a robot. We didn't see any big trouble going from a few logic gates to a computer. Harry said that would be great, and would we please deliver the computer as soon as possible."

"There were a few false starts," said Brian. "Then we spent a couple of all-nighters working on the computer at MIT's AI Lab. We used tons of computer power and came up with a ten-page blueprint for a computer that used a few logic gates but lots of software. After that we spent a month building.

"It had shafts with eccentric wheels, several dozen cams, fishing sinkers, fishing line, escutcheon pins. I remember it was about four feet long, about three feet wide, and three feet high."

"And it came in two pieces," added Margaret. "That was the only way it would fit into the U-Haul trailer we hitched to a Chevy Suburban. Somehow, we squeezed in ten people and drove nonstop from Cambridge to Hot Springs."

"Almost nonstop," said Brian. "When we got there in the middle of the night, we put the two pieces together, and our Tinkertoy computer worked just fine."

"For one game," said Margaret sadly. "Then it stopped and never worked again."

"That's right," said Brian, shaking his head. "We went home a little disappointed."

"What happened then?" I interrupted. "Did they make you take the computer home with you?"

"Nope," said Brian. "They kept it. But two years later, in 1979, or so, Danny got a call from Harry Loucks. He said, 'Your computer still doesn't work. Is there anything you can do to fix it?'

"We decided we would have to rebuild the computer from scratch. The first time I had designed the computer using the MIT AI Lab computers. This time I had a little desktop computer with maybe a millionth the computational power, so I decided I had better take a more clever approach."

"Brian never finished the design," said Margaret; "we were all so eager to begin the new computer. We descended on Hot Springs and Harry's museum from all four points of the compass. We rolled up our sleeves as soon as we arrived and started building."

Brian added, "We sat on the middle of the floor and were a 'live' museum exhibit while we built the new computer. This time we weren't so purist. Some of the Tinkertoys we replaced with wooden dowels which we fashioned with a concrete drill in Harry's basement. We reached the end of the part I had designed after only two days."

"So we just kept building," said Margaret. "It took us a little longer, but we built it right there in the middle of the museum. And it worked! I called them a couple years ago, and they said it's still working."

"It may even be working yet," said Brian.

Historical Footnote

A historical footnote: Digital Equipment Corporation (DEC) took the first Tinkertoy, tic-tac-toe-playing computer and installed it in their Computer Museum in Boston.

I placed a call to the Mid-America Museum in Hot Springs, and the Exhibits Director, Lee Sutton, told me that the second Tinkertoy computer had finally been dismantled. "It worked just fine," said Sutton. "In fact it was impossible to beat. But we're a hands-on museum, and too many hands on the Tinkertoys and it would just come apart."

Do you hear that, Brian? Margaret? Danny? Maybe it's time for the Tinkertoy Gang to reassemble and make a third trek to Hot Springs. Stay tuned. There may be a sequel to this column.

Buyer's Guide to Music Composition and Programming Software

Caroline D. Hanlon

Music makes the world go round. It can also soothe the savage breast and lull babies to sleep. The Commodore 64 and 128 possess the ability to play music and create fascinating sound effects—either as stand-alone units or linked to MIDI. Both amateur and professional musicians can create their own tunes, or modify existing pieces, with the music composition programs found in this buyer's guide. Most of these packages are designed for use with MIDI.

Product Information

The products listed here contain information in the following order: title, publisher, additional requirements (if any) for program use, and suggested retail price.

Advanced Music System
Firebird
(Distributed by Activision)
$59.95

A music creation and editing program, *Advanced Music System* is designed for professional musicians. It consists of six integrated modules—editor, keyboard, synthesizer, linker, printer, and MIDI. The editor can be used to compose, edit, and arrange musical passages while the keyboard module permits the keyboard to be used as the music entry device. The synthesizer module allows sonic tailoring of the waveform and output of the computer's SID chip. The linker feature helps merge and chain passages to develop full-length compositions. The MIDI capability allows control and playback through conventional MIDI keyboards and synthesizers. And with the printer module, music files with lyrics can be printed on dot-matrix printers. The program contains icons and pull-down menus.

Algorithmic Composer
Dr. T's Music Software
$99

Three programs—*Series*, *Phrase*, and *SAC (Stochastic Algorithm Composer)*—are included in this package. With *Series*, users can enter individual series of pitches. *Phrase* helps users generate musical themes using a three-octave scale, and *SAC* allows the creation of four-part harmonies and themes. The programs can play the sequences they create or store them in the *Keyboard Controlled Sequencer* format.

Caged Artist Editors
Dr. T's Music Software
$99

Caged Artist Editors is an assortment of editors and librarians to edit patch parameters. The edit screen displays the patch parameters and highlights the parameter being edited. Patch parameter values can be changed by typing in the new value or incremented or decremented using the joystick or keyboard input. More than one set of patches can be held in memory at one time, and the voice parameters can be printed. Individual editors include the 4-Op Deluxe, Kawai K3, Lexicon PCM-70, Oberheim Matrix 6, and the Roland JX-8P.

Casio Sound Disk
Sonus
Casio CZ-101, 1000, or 5000 synthesizer; MIDI interface card
$49.95

The *Casio Sound Disk* contains ten banks of sounds to use with the Casio line of synthesizers.

Convertifile Plus
Dr. T's Music Software
Music Shop
$75

This utility can help the user convert Dr. T's *Keyboard Controlled Sequencer* or *Passport MIDI 8+* files to *Music Shop* format for editing and scoring in music notation format.

CZ-Patch
Dr. T's Music Software
Synthesizer
$99

With this editor and librarian, musicians can create, edit, and store patches on the Casio CZ-101, 1000, 3000, and 5000 synthesizers. Sets of 16 patches can be stored on disk or transferred between the computer and the Casio memory. The Commodore version holds three sets of patches at once. Envelope parameters can be copied from one envelope to another within a patch, rescaled, and copied to other patches. The data can be displayed as rates and levels. There is a fast edit mode so programmers can experiment with a variety of values with a minimum of keystrokes. Sequences from the *Keyboard Controlled Sequencer* can be played with the program.

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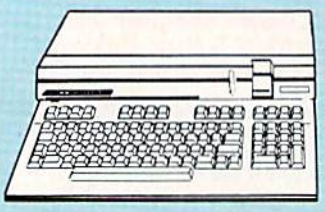

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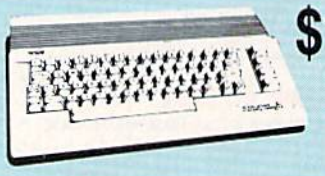

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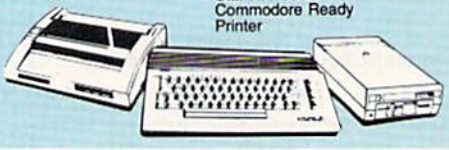

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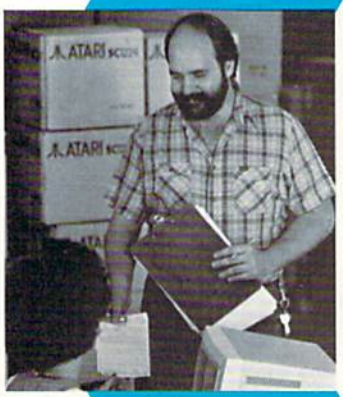

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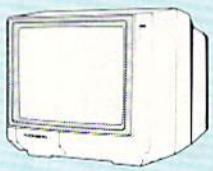

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Dr. T's Music Software
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CZ-Rider can be controlled by joystick, synth keyboard, or computer keyboard. *CZ* parameters can be displayed in the edit screen, while another screen can show color graphs of the envelope level compared to time. The envelopes can be drawn by selecting a point to change and then moving it. The respective sounds are played as the graphs are drawn. Other features include naming voices, copying envelopes between two voices, inserting or deleting steps into an envelope, an adjustable time scale, and printing.

Double-Banked Programmer/Librarian
Sonus
Casio CZ-101, 1000, and 5000 series synthesizer; MIDI interface card
$99.95

With the *Double-Banked Programmer/Librarian,* music programmers can create, edit, and store sounds from the Casio synthesizer or the computer. The sound patches can be rearranged and joined to form tunes. The patches can also be printed out.

DX-Patch Editor and Librarian
Dr. T's Music Software
Synthesizer
$99

Patches for the Yamaha DX7 can be created and stored with this music editor. The program also aids in programming the model DX9 and the TX7 and 8-16 expansion modules. With the program, musicians can attach a keyboard controller or external sequencer to the MIDI in the computer to hear the TX sounds. Sound data is displayed in DX7 format and can be edited. Patch data is displayed on three data screens and can be edited or printed. Two sets of patches can be kept in memory at one time, and over 800 patches can be stored on a disk. Patches can be sent individually or in groups of 32. The patch librarian contains 128 patches. The *DX Patches, Volume 1* disk contains an additional 288 patches and is sold separately.

DX-TX Double Banked Librarian & Programmer
Sonus
Sonus, Passport, Yamaha, or Sequential MIDI interface card and Yamaha DX or TX instrument
$149.95

Programs to use with DX or TX equipment from Yamaha can be created, edited, and saved to disk with the *DX/TX-LP.* This librarian and editing program offers three menus—main, edit, and disk—with four independent levels plus four function keys in each for a total of 48 functions. The program contains two banks of sounds so 64 sounds can be loaded at one time. There are also 20 hidden commands. The A/B selectable feature allows the programmer to see and hear other programs while in the edit menu. Programs, patches, and functions can be printed out. The program disk includes 10 cartridges of 32 patches.

Echo Plus
Dr. T's Music Software
$89

Two separate programs are provided in this package. The first program can operate on one output channel and includes an infinite loop. The second allows the user to define up to four independent or overlapping ranges, and up to 30 delayed notes can be specified. Both programs can start a short sequence for each note played and feature four-way keyboard splits, doubling, MIDI echoes, one-finger chords, and arpeggiated chords.

FB01 Design
Sonus
FB01 FM Sound Generator from Yamaha; Sonus, Passport, or Sequential-compatible interface cards
$99.95

FB01 Design is a double-banked MIDI librarian and editor to use with the FB01 FM Sound Generator from Yamaha. The program contains two independent banks of voices and configurations and can get or send full banks of voices and configurations. Library functions include swap, bank to bank, insert, and delete. The edit mode can update parameters, display algorithms graphically, swap, copy, and initialize. There is also a print-screen feature.

GlassTracks
Sonus
$69.95

This package helps turn the 64 and 128 into a home MIDI recording studio. It includes studio-type controls such as fast forward and reverse, live mute or unmute and punch, assignable velocity, and channel. The sequence edit function permits the programmer to set the end of each sequence, move the sequence, name or rename sequences, append the sequence to itself or another sequence, erase, transpose, and control the MIDI channel assignment and velocity. The track modification menu allows the user to delete pitch and mod wheel information. Tracks can also be transposed, erased, or autocorrected to the nearest thirty-second, sixteenth, eighth, or quarter note. Routines are used to store and append sequences. Other features include a play-thru function, meter adjustment, tempo adjustment by BPM, nondestructive bounce, step record and play, and commands such as OMNI off, all notes off, zero mod wheel, and zero sustain pedal.

Instant Music
Electronic Arts
Joystick optional
$29.95

Instant Music uses red, green, and blue color bars to represent pitch and duration so even nonmusicians can create original music. Any three instruments—including guitar, bass, drums, piano, and sax—can be played at one time, and music can be output to MIDI. Editing features include cut, copy, paste, zoom, volume, and tempo for songs up to 32 measures long. New instrument sounds can be created using the synthesizer feature, and MIDI users can add a drum machine to the piece. A library of over 40 songs is also on the disk. MIDI instruments aren't included.

Keyboard Controlled Sequencer
Dr. T's Music Software
$149 (64)
$225 (128)

This MIDI sequencer offers editing and structuring of music entered by keyboard or synth keyboard. Features include realtime recording, overdub, step-time entry, sequence editing, cut and paste, transpositions, autocorrect, inversions, and time reversals, plus structured sequencing that allows the user to combine different parts or repeat sections of music. A play screen displays the sequencing as the music plays. The 64 version holds 3500 notes and 35 sequences. The 128 version can store 126 sequences and 12,000 notes and contains additional features such as splitting the keyboard and random transpositions.

Master Tracks
Passport
Passport MIDI Interface Card, synthesizers, drum machine, or joystick
$249.95

Users can compose, arrange, and orchestrate music with *Master Tracks,* which offers realtime, step-time, and song-mode sequencing. Realtime sequencing features 16-channel track recording, master clock synchs to and from MIDI sequencers, unlimited amount of tracks with track-mix function, independent track looping, fast forward and rewind, and an over-8000 event memory without loops or repeats. The step-time sequencer contains the Quikstep editor and has cut, copy, and paste options. In the song mode, programmers can step-assemble songs with 16-channel sequences, build songs much like a drum machine, and assemble 256 different sequences using any of 999 steps.

Master Tracks Pro
Passport
Commodore 128, Passport MIDI Interface Card, MIDI-equipped instruments
$299.95

Master Tracks Pro, the enhanced version of the *Master Tracks* sequencer, is a MIDI recording and editing system. The program provides realtime, step-time, and song mode sequencing. Multitrack songs can be created in sections or as continuous works, and users can record or play from any point in the sequence. In addition to the same features found in the original *Master Tracks,* this 128 version offers an "undo" command, an expanded memory capacity, memory-resident modules and data, data filters, and the ability to append sequences together from the disk in recorder module.

MIDI/4 Plus
Passport
MIDI synthesizer, MIDI Interface
$99.95

MIDI/4 Plus is a four-channel recording program that incorporates multitrack tape recorder qualities with unlimited overdubbing on four separate channels, realtime editing, tempo control, and recording of all controllers including key velocity, pitch bend, preset changes, aftertouch, and modulation. Editing features include punch in and punch out, an autocorrect to thirty-second note triplets, and the editing of beats in 24 increments. The sequencer also allows fast forward and rewind.

MIDI/8 Plus
Passport
MIDI synthesizer, MIDI Interface
$149.95

MIDI/8 Plus is an eight-channel MIDI recording program that incorporates multitrack tape recorder qualities with unlimited overdubs to eight channels, realtime editing, tempo control, and recording of all controllers including key velocity, pitch bend, preset changes, aftertouch, and modulation. Editing features include fast forward and rewind, punch in and punch out, single-step playback, and 24-increment editing of beats. A tape sync feature requires an external sync box or Passport's MIDI Interface with tape sync.

MIDI Processor
Sonus
Super Sequencer or *Studio I* data files; Sonus, Passport, or Sequential MIDI interface card
$119.95

Data files created with sequencing software—*Super Sequencer* and *Studio I*—can be loaded and edited with *MIDI Processor*. Single events or ranges of events can be edited with the micro and macro editing functions. Range edits include transposing tracks, velocity level, velocity scale, autocorrect, removal of program changes, erasing or keeping a track in a range, and bouncing a track from one sequence to another. The program offers other features such as viewing individual MIDI events, live punch, playback mute controls, disk utilities, and a seam manager.

MidiTech 64
Sonus
MIDI interface card, MIDI device
$99.95

MidiTech 64 is a monitor and system-exclusive librarian to view, send, receive, manipulate, and save MIDI bytes sent from MIDI devices such as keyboards, drum machines, and sequencers. It features programmable MIDI filters, MIDI trigger functions, receive with prefix send capability, system-exclusive dump requests, and an over-25K receive and send buffer. The monitor edit functions include edit, insert, delete, ten programmable go-to points, fill, and hunt. Handshake protocols can be saved to disk. System-exclusive dumps can be saved to disk and are compatible with the *Super Sequencer*. *MidiTech 64* includes system-exclusive dump requests for the CZ101, RX11, DX/TX, FB01, KORG 600, and LINN drum.

The Music Shop for MIDI
Passport
MIDI Interface Card, MIDI synthesizer or drum machine, printer optional
$149.95

With this program, users can compose, edit, and print music. The editor allows the user to move or erase blocks of music, pick up a note once and place it any number of times, and input notes from the MIDI keyboard. Eight voices can be assigned to four different MIDI channels. Sheet music can be printed in piano, single staff, or quartet formats. Each musical piece can be up to 20 pages in length. The program supports all key signatures and uses pull-down menus and windows.

The Music Studio
Activision
Joystick optional
$34.95

Professionals and amateurs can use this program to create their own musical compositions. The editor lets users change tempo, duration, and volume. New instruments and sound effects can be created by modifying the attack, sustain, release, and decay features. The paintbox provides a place for experimenting with new sounds or melodies, and the piece can then be copied into the editor. The music can be printed in sheet-music form, and the program can be used with electronic keyboards. Up to three verses can be added to a song, and a library of original compositions is included.

The Music System
Firebird
(Distributed by Activision)
$39.95

This musical utility package consists of two modules. The editor/keyboard module can be used to create compositions note by note and store the music digitally. In this module, notes are stored in standard musical notation, and three voices are allowed. The synthesizer permits definition and control of the settings and output of the SID chip. The mix, sound, and melody can be altered as the piece is played. There is also a built-in metronome feature. Pull-down menus and documentation are included.

Passport MIDI Voice Editor for FB-01
Passport
MIDI Interface Card, Yamaha FB-01 synthesizer
$125

This package is a voice librarian and editing system for Yamaha's FB-01 synthesizer module. The program allows users to organize and edit sounds for the FB-01, create a library of voices and configurations, organize setups, and send, receive, copy, move, name, and print banks of voices and configurations. Voice parameters can be edited. Channel assignments are provided for both MIDI In and MIDI Out.

Rock 'N' Roll Studio
Spinnaker Software
Joystick
$6.95

As owner of a recording studio, the user can create a song, store it in the jukebox, and play it back with the touch of a few buttons.

RX Librarian
Sonus
Yamaha RX11 or RX21 drum machine, MIDI interface card
$69.95

The *RX Librarian* contains over 150 jazz, Latin, and rock drum patterns to use with the Yamaha RX11 or RX21 drum machines. With this program, drum patterns and mixes can be named, edited, and stored. Twenty lines of comments can also be entered with the files and stored or printed out.

Songwriter
Thunder Mountain (Mindscape)
$9.95

Songwriter can help students with limited musical skills create and save tunes to play on the computer. Piano-roll graphics and notations are used for composition. A library of songs is included on the disk. For grades 1–8.

Sonic Editor
Sonus
Prophet or Ensoniq Mirage sampling keyboard; Sonus, Passport, Sequential, or compatible MIDI interface card
$99.95

A graphics waveform editor and sound management system, *Sonic Editor* consists of three main parts—parameter options, edit mode, and program library and disk storage. With the parameter options, wavesample or program parameters from the lower or upper half of the keyboard can be displayed. Displays include loop start and end, loop fine adjust, top key value, LFO frequency, OSC detune, mix, and filter values. The edit mode includes three methods for drawing and editing waveforms—scrolling the waveform, drawing on the screen, or manually plotting points. Single-page waveforms and preset parameters can be stored on-board with the program library to provide 78 sounds. Sets of 78 sounds can be stored on disk, and a library of 78 preprogrammed sounds is provided with the program. The program also includes a dot/line mode display and screen print. *Sonic Editor* is available for the Prophet or Ensoniq Mirage sampling keyboard.

Sound File
Blank Software
Disk drive, joystick or mouse, Ensoniq ESQ-1 2.0
$69.95

This sound and sequence librarian program for the Ensoniq ESQ-1 Digital Wave Synthesizer can use up to four sound banks at one time and has two patch libraries, each holding up to 120 sounds. Musicians can move the patches within

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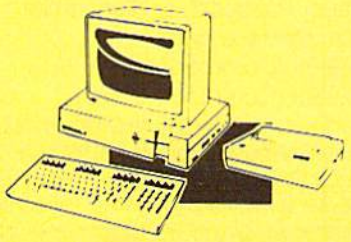

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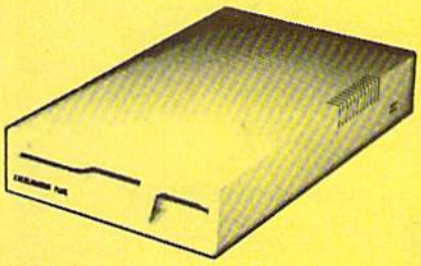

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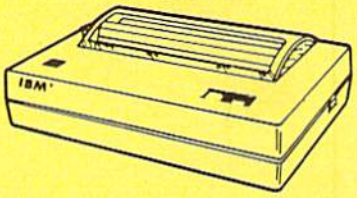

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VISA — MASTERCARD — C.O.D.

and between banks and libraries and can combine songs to create new song banks. A disk can store up to 1600 patches. The program uses windows and pull-down menus plus a joystick- or mouse-driven operating system. *Sound File* requires Passport, Sequential, or European MIDI interface, a Commodore joystick or mouse, and the Ensoniq ESQ-1 version 2.0 or higher.

Super Sequencer Series
Sonus
Sonus, Passport, or Sequential MIDI interface card
$189.95 (Commodore 64)
$229.95 (Commodore 128)

A series of recording and librarian routines for professional music programming, the *Super Sequencer Series* contains a built-in MIDI system-exclusive librarian and studiolike controls such as fast forward, live mute, and assignable velocity. The programmer can set the beginning and end of each sequence, move the sequence, and control MIDI channel assignment and velocity. The track modification menu can be used to delete pitch wheel, mod wheel, sustain pedal, or volume change. Sequences can be arranged into songs, and up to four songs can be arranged in memory at one time. Additional features include time-base transfer, captive play-thru function, autocorrect, and velocity leveling. The 128 version has a command to record changes in MIDI volume data to convert the master keyboard's mod wheel into a MIDI volume control.

VDS Mirage
Dr. T's Music Software
Ensoniq Mirage synthesizer
$129

An editing system for the Ensoniq Mirage synthesizer, this program can graphically display and edit waveforms, waveshaping synthesis, Fourier transforms, additive synthesis, and FM synthesis.

Virtuoso 64
Chipmunk
$29.95

Virtuoso 64 is a music editor to help the user create sound effects and background music. The interrupt-driven music code can be added to BASIC or machine language programs.

Publisher's Information

Activision
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Blank Software
1034 Natoma St.
San Francisco, CA 94103

Chipmunk Software & Systems
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Battleground, WA 98604

Dr. T's Music Software
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Helpful Hints

David Iwanicki

After purchasing the new *GEOS 128* package, I noticed that some of the functions do not work as stated in the manual. Here is a list of some of the problems I've had and the solutions I've discovered.

Problem: You are using geoWrite or geoPaint on a two-drive system. The application, fonts, and accessories are all on one disk, and you're creating the document on the other drive. If you pull-down the *GEOS* menu, you'll see the accessories, but when you try to open and use one, nothing happens.

Solution: Place the application and the fonts and accessories you think you'll use on the disk with your documents.

Problem: You have just purchased a new application (*Writer's Workshop, geoCalc 128,* or another). You follow the instructions in the manual, but you get an error message stating: "Application may not be installed on this disk."

Solution: This one happened to me with *Writer's Workshop 128.* After a lengthy discussion with Berkeley, we came up with this step-by-step solution. First, click on the file CONFIGURE 128 (it's on the BOOT disk). Next, click on Drive A: No drive. When the screen is redrawn, click on Drive A: 1541. Choose QUIT from the File menu. Now install the application on Drive A. When you're finished, you can configure the drive back to its original setting. Note that *GEOS* can tell what types of drives are installed, and, if no configuration has been saved, it will use each drive in its native configuration.

Warning: *GeoPaint 128* users should be aware that lines have a habit of remaining on the screen after pulling down a menu. This effect almost always occurs when you have a TEXT window open or when you have selected a portion of the screen and it's still active. The TEXT cursor can become a part of the display, but it won't be in the document. It remains until you exit to the deskTop. The best way to avoid those unwanted lines is to make sure that the PENCIL is the active drawing device before you pull down Geos or File.

Problem: You have dozens of fonts, but when you try to use them all in a document, only some are available.

Solution: Only the first eight fonts on the disk are available for use in a document (not including the system fonts BSW and BSW 128.) To change the eight fonts available, move them around on the deskTop.

GEOS 128 and the 1581

Dale McBane

There are a variety of disk drives and RAM Expansion Units (REUs) available for the 64 and 128. *GEOS* and *GEOS 128* both support the Commodore RAM expanders (the 1700, 1750, and 1764) and the 1541 and 1571 disk drives. In addition, *GEOS 128* supports the 1581 drive.

When an REU is used with *GEOS* or *GEOS 128,* it can be configured for direct memory access (DMA) data transfer, for disk buffering, or for simulating a disk drive with a ramdisk. Using an REU as a ramdisk can cause some *GEOS* applications to execute much faster than with a disk drive. The speed of a ramdisk makes using *GEOS* much easier, but data stored in a ramdisk isn't permanent. When the power is turned off, the contents of the ramdisk are gone. While real disk drives can't match the speed of a ramdisk, the data stored on them does survive powering down.

Of the disk drives supported by *GEOS 128,* the 1541 is the oldest and the slowest. The 1541 is a single-sided drive with the storage capacity of 165K. Because it uses both sides of the disk, the 1571 can store more data on each disk than the 1541. The 1571 has a storage capacity of 331K, just over double that of the 1541. The 1571 not only stores more data per disk than the 1541, it also transfers that data to and from the computer more quickly. The 1571 supports two methods of fast transfer.

The 1581 is fast. While it's not as fast as a ramdisk, it is slightly faster than the 1571. For most applications, the speed difference between the 1571 and the 1581 is unnoticeable. The 1581's best feature is its huge capacity—it can store 790K of data on a single disk. That's nearly five times the capacity of a disk formatted on the 1541. With the 1581, you can keep all your applications, data, and reference files on the same disk. For example, if you're using *geoProgrammer* to work on a large project, you could keep geoWrite, geoPaint, the text manager, the photo manager, geoAssembler, geoLinker, geoDebugger, geosSym, geosMac, fonts, the deskTop, any desk accessories you might need, and your source files on the same disk. No more swapping!

Right now, the *GEOS 128* boot disk isn't available in 3½-inch format, and Berkeley hasn't announced that one will be made available. If Berkeley does put *GEOS 128* on 3½-inch disks, a powerful development system could be built around it. Just imagine booting *GEOS 128* from a disk containing every application you might want to use and having a ramdisk to store your data files on. If you play around with 128 CONFIGURE enough, you can approximate such a system, but it takes a while. The optimum *GEOS* environment is close at hand, and the REU and 1581 are major contributors.

the programmer's page

That Won't Work

Randy Thompson
Contributing Editor

"The Programmer's Page" is interested in your programming tips and tricks. Send all submissions to The Programmer's Page, COMPUTE!'s Gazette, P.O. Box 5406, Greensboro, NC 27403. We'll pay $25–$50 for each tip we publish.

I like to do things with BASIC that most people think BASIC can't do—use commands for things they weren't designed to be used for. I get a certain pleasure from writing compact, efficient, and often cryptic code that people look at and say, "That won't work," but it does. Sometimes, this is the only way to get BASIC to do what you want.

To see what I mean, take a close look at the following programming tricks for the 64. Each one makes use of BASIC's too-often-ignored DEF FN statement. Don't refer to your BASIC manual to see what DEF FN is *supposed* to be used for, because it won't help. I'm going to show you how to use DEF FN for something entirely different: to store and execute machine language routines.

Name That Tune

Here's the first routine. See if you can guess what it does.

```
BD 10 POKE 784,108:POKE 785,12
      2:POKE 786,0
XR 20 DEF FN BP(X)=USR(162)+PO
      S(" {A}{U}{SHIFT-SPACE}!
      {F8}{A}T{F8}{D}T
      {SHIFT-SPACE}T{F8}{F}T
      {SHIFT-SPACE}T0}{5}{F8}
      {X}T{F1}{2 I} {F3}IJ <
      {U}{£}{F8}{X}TL;£")
HD 30 X=FN BP(0)
```

If you answered *beep*, you're right. (As you can see, this isn't exactly phonetic programming.) This command is very similar in function to the PRINT CHR$(7) statement on the 128, except here, an X=FN BP(0)—not a PRINT statement—causes the SID chip to voice its opinion. As long as lines 10 and 20 have been executed, you can use this command to prompt, alert, or simply annoy the user.

Be especially careful when entering the routines listed in this column. A single mistyped character in one of the program's DEF FN statements can cause the computer to lock up when the program is run. Please note that there are no spaces between the USR function, plus sign, or POS statement in line 20.

To ensure accurate typing, use "The Automatic Proofreader" program found elsewhere in this issue. It's also important that you read "How to Type In *COMPUTE!'s Gazette* Programs," also found in this issue, to see how to type in special characters.

You can combine any or all of the routines provided in this article. The only limitation is that you must execute the DEF FN commands at least once before they're used. (In the example above, line 20 must be executed before line 30.) For this reason, it's best to include the DEF FN statements at the beginning of a program. As with most BASIC commands, the line numbers may change, but not the code.

You might notice that line 10 is the same in each of the following programming examples. As long as you don't enter NEW, you can avoid retyping this line. Just enter lines 20–250 of each routine while the previous program is still in memory.

Selective RESTORE

Most versions of BASIC—including those found on the 128 and Plus/4—have a RESTORE command that accepts a line number as an argument. Add this feature with the following code:

```
BD 10 POKE 784,108:POKE 785,12
      2:POKE 786,0
RC 20 DEF FN RS(LN)=USR(LN)+PO
      S(" {A}{U} {T}{2 £}F<
      {G}<L'{£}")
JE 30 X=FN RS(50):READ S$:PRIN
      T S$
HP 40 DATA FIRST
XD 50 DATA SECOND
```

As demonstrated in line 30, to RESTORE BASIC's data pointer to a selected line number, use the command

X=FN RS(*line number*)

where *line number* is a number, variable, or even an expression, such as **1000+I*10**. If you want, you can replace X with the variable of your choice. When the selective RESTORE command is executed, this variable is scrambled.

Super POKE

I'm sure you're familar with the BASIC loader—you know, a FOR-NEXT loop that READs in numbers from DATA statements and laboriously POKEs them into memory. This next trick makes BASIC loaders obsolete.

```
BD 10 POKE 784,108:POKE 785,12
      2:POKE 786,0
KR 30 DEF FN P(X)=USR(X)+POS("
      {I}D{J}6{F1}={J}7{F1}>
      {K}£ >£ {F}{D}{X} +{C}
      {P}{C}L{R}{Y} {K}{Y} '
      {U}£{A}{F1}{G}{X} {2}£
       Y{£}L{P}{C}")+D
QR 40 POKE 53280,0:POKE 53281,
      0:POKE 646,1:PRINT CHR$(
      147)
AB 50 V=53248:POKE 2040,11:POK
      E V+21,1:POKE V,24:POKE
      {SPACE}V+1,53:POKE V+39,
      7
XK 60 PRINT "{2 SPACES}. . . .
       . . . . . .":PO
      KE 704,FN P(0)
HK 100 DATA 000,000,000,000,25
      5,000,003,255
DJ 110 DATA 192,015,255,240,03
      1,231,248,063
HH 120 DATA 227,252,127,255,24
      8,255,255,224
MX 130 DATA 255,255,128,255,25
      4,000,255,248
AS 140 DATA 000,255,248,000,25
      5,254,000,127
KS 150 DATA 255,128,063,255,22
      4,031,255,248
JE 160 DATA 015,255,240,003,25
      5,192,000,255
BD 170 DATA 000,000,000,000,00
      0,000,000,-1
```

When run, this brief program quickly and efficently takes a sprite

definition stored in DATA statements, POKEs it into memory, and displays the results—all without using FOR, NEXT, or READ.

The syntax for this super POKE is

POKE *address*, FN P(0)

where *address* is the starting address for the data to be stored. A −1 must be used to signify the end of data. Otherwise you'll get an ?OUT OF DATA ERROR. So, the statement

POKE 49152, FN P(0): DATA 1, 2, 3, 4, −1

is equivalent to

FOR I=49152 to 49155: READ D:POKE I,D: NEXT I: DATA 1, 2, 3, 4

When used to store 1K–3K worth of data, the first method is not only shorter, it's almost three times as fast.

Note: This routine POKEs a zero directly after the last piece of data stored in memory. This is important to know if you plan on storing data directly below a machine language routine. Also, after the routine is executed, the numeric variable D is set equal to the last piece of data read. Keep this in mind if you use D in your own programs.

This routine makes a perfect complement to the selective RESTORE program above. Together, they make a powerful team. To illustrate their combined use, type in and run the following program.

```
BD 10 POKE 784,108:POKE 785,12
      2:POKE 786,0
RC 20 DEF FN RS(LN)=USR(LN)+PO
      S(" {A}{U} {T}{2 £}F<
      {G}<L'{£}")
KR 30 DEF FN P(X)=USR(X)+POS("
      {I}D{J}6{F1}={J}7{F1}>
      {K}£ >£ {F}{D}{X} +{C}
      {P}{C}L{R}{Y} {K}{Y} '
      {U}£{A}{F1}{G}{X} {2}£
       Y{£}L{P}{C}")+D
QR 40 POKE 53280,0:POKE 53281,
      0:POKE 646,1:PRINT CHR$(
      147)
AB 50 V=53248:POKE 2040,11:POK
      E V+21,1:POKE V,24:POKE
      {SPACE}V+1,53:POKE V+39,
      7
XK 60 PRINT "{2 SPACES}. . . .
       . . . . . .":PO
      KE 704,FN P(0)
CF 70 FOR I=24 TO 255 STEP 8
MF 80 X=FN RS(100+10*(I AND 8)
      ):POKE 704,FN P(0):POKE
      {SPACE}V,I:POKE 1061+I/8
      ,32
HM 90 NEXT
HK 100 DATA 000,000,000,000,25
      5,000,003,255
DJ 110 DATA 192,015,255,240,03
      1,231,248,063
HH 120 DATA 227,252,127,255,24
      8,255,255,224
MX 130 DATA 255,255,128,255,25
      4,000,255,248
AS 140 DATA 000,255,248,000,25
      5,254,000,127
KS 150 DATA 255,128,063,255,22
      4,031,255,248
JE 160 DATA 015,255,240,003,25
      5,192,000,255
BD 170 DATA 000,000,000,000,00
      0,000,000,-1
HX 180 DATA 000,000,000,000,25
      5,000,003,255
DS 190 DATA 192,015,255,240,03
      1,231,248,063
PS 200 DATA 227,252,127,255,25
      4,255,255,255
XM 210 DATA 255,255,255,255,25
      5,255,255,248
HR 220 DATA 000,255,255,255,25
      5,255,255,127
JE 230 DATA 255,254,063,255,25
      2,031,255,248
EP 240 DATA 015,255,240,003,25
      5,192,000,255
QH 250 DATA 000,000,000,000,00
      0,000,000,-1
```

This animated program moves a hungry character across the screen.

How (and Why) They Work

Normally, DEF FN is used to DEFine mathematical FuNctions which are calculated whenever the function name is used in an equation. (Function names are always preceded by the letters *FN*.) In the programs above, however, DEF FN is used to store and execute machine language subroutines. In order to make this work, another sorely neglected BASIC command is put to use: the USR function.

Like SYS, USR executes machine language subroutines. Notice that each of the DEF FN functions begins with a USR command. Every time one of these functions is used, USR is put into action.

Normally, memory locations 785 and 786 hold the address of the machine language routine that USR executes. It's the responsibility of the programmer to set these locations. And again, *normally*, memory location 784 contains the 6502 instruction, JMP. So whenever a USR command is encountered, the computer jumps to location 784, from there jumping to the address contained in locations 785 and 786.

To make these DEF FN routines work, the first thing I had to do was exceed the norm. Line 10 removes the JMP command normally found at location 784 and replaces it with an *indirect* JMP. Now, instead of jumping to the address contained in 785 and 786, the computer jumps to the address *pointed to* by the address contained in 785 and 786. (Don't worry if you don't understand any of this. You can still use the programs without knowing how they work.)

In every routine listed above, USR jumps to the address pointed to by locations 122 and 123 ($7A and $7B), otherwise known as BASIC's text pointer (TXTPTR). These two locations point to the current character in the current BASIC line. In our case, when the USR function is executed by BASIC, TXTPTR points to the plus sign (+) that follows the USR statement.

Now it just so happens that the plus sign, the POS function, the open parenthesis, and the quotation mark that follow the USR statement make up a series of harmless and completely legal 6502 machine language instructions. This is good, because when the computer's microprocessor finishes with those instructions, it reaches the important stuff: the strange characters stored between quotation marks.

These characters were not chosen randomly; they were carefully selected machine language instructions. If you own a machine language monitor, you can disassemble these strings and see exactly what's going on. In most cases, the machine code begins at 2105 ($0839). It's these ML routines that accomplish the actual beeping and POKEing.

It's Your Turn

Now, I know I'm not the only one with a few tricks up my sleeve. So if you have a unique use for a neglected BASIC command, know of a great way to outdo DOS, or have just written a powerful hack that you've been dying to confess to, send it to "The Programmer's Page," c/o *COMPUTE!'s Gazette*. If we can use it, we'll mention it here and—here's the good part—pay you for it. Depending on the quality and originality of the work, we pay $25–$50 for each published submission.

Since this is the first installment of "The Programmer's Page," I'm very interested in your comments. What type of programming tips are you most interested in? Do you want more tricks and less explanation, or the other way around? I'm open for suggestions, questions, or comments. Remember: You're the programmer, and this is your column.

RAM Expander 64

Peter M. L. Lottrup

By adding four new commands to BASIC 2.0—including STASH and FETCH—this short utility makes accessing RAM expansion memory a breeze. For the 64 with 1764 RAM expansion module, or the 128 with 1700 or 1750 module.

When the Commodore 64 was introduced, 64K of RAM was considered a great deal of memory. Times change. To satisfy the ever-increasing demand for RAM, Commodore released three expansion modules. "Ram Expander 64" adds commands to BASIC to make it easy to access memory in these expanders.

The RAM expansion modules for the 64 (the 1764) and 128 (the 1700 and 1750) all are driven by a chip known as the RAM Expansion Controller (REC). This chip is capable of performing four data operations between main memory and expansion memory: storage, retrieval, exchange, and comparison. BASIC 7.0 on the Commodore 128 features built-in commands—STASH, FETCH, and SWAP—that handle the first three operations. "RAM Expander 64" adds identical commands to the 64's BASIC 2.0, as well as a fourth command (COMPARE). With this program in place, you can access any of the expansion modules on a 64 or from within 64 mode on the 128.

Installation

RAM Expander 64 is a fully relocatable machine language (ML) routine in the form of a BASIC loader. Only 209 bytes in length, this routine is stored in DATA statements and POKEd into memory by the BASIC program. Type in the loader and save a copy to disk or tape. To ensure accurate entry, use the "Automatic Proofreader" program found elsewhere in this issue.

When you run the program, you're asked to choose the memory location where the ML program will be placed. Enter an address that won't conflict with any other programs in memory. If you press RETURN without specifying an address, RAM Expander 64 is placed at location 49152 ($C000). After the routine is POKEd into memory, the program SYSes to the start address to activate the new commands.

Pressing RUN/STOP-RESTORE has no effect on RAM Expander 64. Also, if you're in 64 mode on a 128 and accidentally reset the computer, you haven't lost the program. Just reenter 64 mode (by typing GO64 or by holding down the Commodore key while pressing the reset switch) and SYS to the starting address to reinstall the program. In this case, the contents of the memory expansion module should also remain intact.

Using the Program

RAM Expander 64 adds four new commands to BASIC 2.0: STASH, FETCH, SWAP, and COMPARE. The first three commands work like their counterparts on the 128. The fourth command (COMPARE) is similar to the VERIFY command for disk. It compares the contents of a section of the computer's memory and a section of the expansion memory, reporting a VERIFY ERROR if the data differs.

To be interpreted properly by BASIC, expansion commands must be preceded by an exclamation point and followed by four parameters. Each command takes the following form:

!COMMAND *a,b,c,d*

where *a* is the number of bytes to transfer or verify, *b* is the base address of the memory block on the 64 (0–65535), *c* is the base address of the expansion memory (0–65535),

and *d* is the expander bank number (0–1 on the 1700, 0–3 on the 1764, and 0–7 on the 1750).

For example, suppose you wanted to use the expansion RAM for program storage—much like a ramdisk. Assume that a 2000-byte ML program you need to save is located at 49152. To transfer it to location 0 of bank 1 in the expansion RAM module, you'd enter

```
!STASH 2000,49152,0,1
```

To later retrieve the program, type

```
!FETCH 2000,49152,0,1
```

You can also use RAM Expander 64's commands from program mode. For instance, let's say you wanted to exchange the current text screen with a screen display previously stashed in bank 0, location 0. To repeat the switch ten times, run the following one-line program:

```
10 FORI=1TO10:!SWAP1000,1024,0,0:
   FORJ= 1TO500:NEXTJ,I
```

COMPARE is just as easy to use. Suppose you wanted to compare an ML program at location 51000 with one you stored in bank 1, location 5000. Assuming both programs are 1500 bytes long, you'd enter

```
!COMPARE 1500,51000,5000,1
```

If the two programs differ, a VERIFY ERROR appears.

How It Works

When enabled, RAM Expander 64 redirects BASIC's GONE routine—which executes the next BASIC statement—to point to itself. Whenever you enter a line of code, the program first checks for an exclamation point. If one is found, it then compares the command which follows with each of its own—either STASH, FETCH, SWAP, or COMPARE. If the command matches one of the four RAM Expander commands, the program uses the four parameters that follow to set up the appropriate REC registers, which are memory-mapped at location 57088 ($DF00).

Prior to executing the actual expander operation, RAM under BASIC ROM is switched in. (The program requires that Kernal ROM remain visible.) Once the expander operation has taken place, BASIC ROM is switched back in and BASIC continues its normal execution.

See program listing on page 69.

power BASIC

128 Shell Booter

David F. Ockrassa

If you've had trouble copying the 1571 DOS Shell to a double-sided disk, you're in luck—"128 Shell Booter" does the work for you.

The DOS Shell is a program found on the 1571 Test/Demo disk, which comes with every Commodore 1571 disk drive. The Shell is designed to make it easy for the user to format disks, copy files, and perform other disk-oriented tasks. Unfortunately, it's very difficult to move DOS Shell to another disk, especially to a double-sided work disk. "Shell Booter" makes the chore easy.

Using the Program

In 128 mode, type in and save Shell Booter. To ensure accurate entry, use "The Automatic Proofreader," located elsewhere in this issue. Do *not* save the program with the name SHELL.BOOTER—the BASIC program will attempt to save a file with that name. If you mistakenly enter the program in 64 mode, line 30 will not be properly tokenized. In this case, go to 128 mode, load the program, list line 30, place the cursor on the line, and press RETURN. The line will now be properly tokenized. Save the program to disk.

Reboot your computer with the 1571 Test/Demo disk. Now press F1 to enter the DOS Shell. Use the COPY file option to copy DOS Shell to any disk. Now, use the COPY file option to copy Shell Booter to the same disk. Exit DOS Shell.

Load Shell Booter from the new disk and type RUN. The program creates a machine language program called SHELL.BOOTER.

Now, whenever you'd like to use DOS Shell, just type **BOOT "SHELL.BOOTER"**.

How It Works

The reason DOS Shell is so difficult to transfer is that it requires the Bank 12 configuration of the 128. It also resides in the BASIC workspace. The necessary setup is performed by the boot sector, which is read automatically when you turn on your 128.

Since it is not a file, the boot sector is difficult to copy. You could use a sector copier to copy the whole disk, but then you would end up with a single-sided disk.

The Shell Booter machine language program fills in for the boot sector, loading the program, switching in the correct bank, and altering certain pointers.

See program listing on page 78.

COMPUTE!'s Gazette is looking for utilities, games, applications, educational programs, and tutorial articles. If you've created a program that you think other readers might enjoy or find useful, send it, on tape or disk, to: **Submissions Reviewer, COMPUTE! Publications, P.O. Box 5406, Greensboro, NC 27403.** Please enclose an SASE if you wish to have the materials returned. Articles are reviewed within four weeks of submission.

• "Ramdisk 64" (June 1988) will not load files from the ramdisk correctly. The program listing printed in the magazine is missing 256 bytes, which contain the LOAD routine. (The disk version is correct.) To fix the problem, type in the machine language listing below using "MLX," the machine language entry program found elsewhere in this issue. When MLX prompts you for the starting and ending addresses, reply with the following values:

Starting address: 0A4E
Ending address: 0B4D

After you've saved a copy of the correction, turn off your 64 and turn it back on. Next, load the defective copy of Ramdisk 64 (LOAD "*filename*",8 for disk or LOAD"*filename*",1 for tape). Then load the correction (LOAD"*filename*",8,1 for disk or LOAD"*filename*",1,1 for tape). Now, save the corrected copy of Ramdisk as you would any BASIC program. Be sure to use a new filename when you save.

```
0A4E:40 0B A0 00 B1 BB C9 2A 93
0A56:F0 12 C8 C8 D1 06 F0 07 9C
0A5E:A5 0A A4 0B 4C 3B 0A 88 F8
0A66:C4 B7 D0 E8 A5 06 48 A5 EE
0A6E:07 48 B1 06 F0 03 C8 D0 A4
0A76:F3 C8 18 98 65 06 85 0A 9B
0A7E:A5 07 69 00 85 0B A0 00 ED
0A86:38 B1 06 F9 0A 00 99 02 09
0A8E:00 C8 C0 02 90 F3 A5 0A B6
0A96:A4 0B 85 06 84 07 A5 2B 87
0A9E:A4 2C 85 08 84 09 20 7A 44
0AA6:09 20 45 09 A5 08 85 2D 06
0AAE:85 2F 85 31 A5 09 85 2E 9F
0AB6:85 30 85 32 20 74 09 68 BA
0ABE:85 09 8D 30 09 68 85 08 89
0AC6:8D 2F 09 A0 01 B1 08 99 11
0ACE:06 00 88 10 F8 A0 01 B1 F5
0AD6:06 D0 18 91 08 88 10 FB BC
0ADE:A0 01 B9 08 00 99 04 00 A9
0AE6:88 10 F7 20 7A 09 4C 3A 0F
0AEE:0B B1 06 99 0A 00 88 10 C0
0AF6:F8 38 A5 0A E5 06 85 02 3F
0AFE:A5 0B E5 07 85 03 A5 0B 64
0B06:C9 E0 90 0D A5 07 C9 E0 D9
0B0E:B0 07 38 A5 03 E9 10 85 05
0B16:03 20 7A 09 20 45 09 20 DD
0B1E:74 09 AD 2F 09 85 0A AD 79
0B26:30 09 85 0B A0 01 B9 08 7C
0B2E:00 91 0A 99 2F 09 88 10 42
0B36:F5 4C D3 0A 20 31 09 4C 99
0B3E:74 A4 20 7A 09 20 31 09 97
0B46:A2 04 4C 4B 08 00 00 00 2D
```

• Line 30 of "Key Clicker" (April 1988) was listed incorrectly. The 64 version never executes line 30, so it may be deleted from that version. Below is a replacement line for the 128 version.

```
QP 30 BANK15:A=2816:V=828:T=68
      :Z=6473:C=2
```

• Versions of "128 MLX" printed before the version in this issue return to BASIC with a FILENAME TOO LONG ERROR if the user enters a filename longer than 14 characters when saving. Add the following line to correct the problem.

```
PF 665 IF LEN(F$)>14THEN660
```

128 MLX has been corrected in this issue and on the August Disk.

• As we reported last month, there is a problem with the print routine in "Speed File" (April 1988). The program doesn't print because an incorrect secondary address is used when opening the file to the printer. There is also a problem with some characters being invisible on older 64s. The characters don't appear on the screen because the clear screen routine in an older version of the ROMs doesn't set color memory correctly. The following patch program corrects both of these problems.

```
SP 10 T=828:X=0
CD 20 READ A:IF A<0 THEN40
QB 30 X=X+A:POKE T,A:T=T+1:GOT
      O20
KD 40 IF X<>19631 THENPRINT"ER
      ROR IN DATA":STOP
KS 50 F$="SPEEDFILE":REM IF YO
      U USED A DIFFERENT NAME,
       SUBSTITUTE IT HERE
HG 60 T=LEN(F$):POKE 972,T
HA 70 FOR I=1 TO T
DM 80 POKE 972+I,ASC(MID$(F$,I
      ,1))
QC 90 NEXT:POKE7669,169:POKE76
      70,0:POKE7671,168:POKE76
      72,32:POKE7673,189
KB 100 POKE7674,255:POKE7675,1
      69:POKE7676,4:SYS828
AA 110 DATA169,1,162,8,160
XB 120 DATA0,32,186,255,173
MS 130 DATA204,3,162,205,160
AQ 140 DATA3,32,189,255,169
JP 150 DATA0,166,43,164,44
CP 160 DATA32,213,255,134,45
HQ 170 DATA132,46,32,51,165
MP 180 DATA169,8,133,252,169
JH 190 DATA1,133,251,169,0
XQ 200 DATA133,253,170,168,177
EE 210 DATA251,221,201,3,240
CP 220 DATA19,200,208,246,165
BG 230 DATA252,24,105,1,133
RH 240 DATA252,133,254,201,35
AD 250 DATA208,233,76,13,8
JP 260 DATA232,224,3,208,232
GA 270 DATA162,0,169,153,145
HA 280 DATA253,169,3,145,251
FA 290 DATA76,116,3,201,147
BS 300 DATA240,6,201,19,240
FQ 310 DATA2,208,35,141,204
MG 320 DATA3,152,72,173,204
CS 330 DATA3,32,210,255,169
CS 340 DATA0,168,153,0,216
BE 350 DATA153,0,217,153,0
KC 360 DATA218,153,232,218,136
HS 370 DATA208,241,104,168,173
XG 380 DATA204,3,96,76,210
AF 390 DATA255,32,210,255,-1
```

To use the patch program, simply load it and type RUN. It will load Speed File (using the filename SPEEDFILE), make the corrections, and then run the program. Because Speed File stores its data immediately following the program, the patch program and Speed File can't easily be merged into one file. Each time you use Speed File, load and run the patch program, and Speed File will automatically load and run correctly.

Moving?

For address changes or subscription information, call toll free

1-800-727-6937

User Group Update

Mickey McLean

The following list includes updated entries to our annual "Guide to Commodore User Groups," which last appeared in the May and June 1988 issues.

When writing to a user group for information, please remember to enclose a self-addressed envelope with postage that is appropriate for the country to which you're writing.

Send typed additions, corrections, and deletions for this list to:

COMPUTE! Publications
P.O. Box 5406
Greensboro, NC 27403
Attn: Commodore User Groups

User Group Notes

A Bakersfield Area Commodore Users Society (ABACUS) has a new mailing address. All correspondence should now be sent to P.O. Box 40334, Bakersfield, California 93306. ABACUS also has a bulletin board service. The telephone number is (805) 832-7186.

The **Triple Cities Commodore Society** has changed its mailing address to P.O. Box 476, Binghamton, New York 13902.

The **Howard S. Bacon, KC4CIQ** user group in South Pittsburg, Tennessee, has a bulletin board number that is in operation from 9 p.m. Friday to 6 a.m. Monday. The telephone number is (615) 837-8352.

The third annual Chicagoland Commodore Computerfest is being presented by the **Fox Valley 64 Users Group** on August 28 at the Exposition Center on the Kane County Fairgrounds in St. Charles, Illinois. The show will feature national speakers, venders, and products for the Commodore 64, 128, and Amiga. For more information write to Computerfest, P.O. Box 28, North Aurora, Illinois 60542.

New Listings

ARIZONA

Phoenix Arizona Commodore Club (PACC), P.O. Box 34905, Phoenix, AZ 85067

CALIFORNIA

Pasadena Commodore Computer Club, P.O. Box 1163, Arcadia, CA 91006

Association for Sharing Commodore Information (ASCI), 8395 Ninth St., Rancho Cucamonga, CA 91730

Victor Valley Commodore Interest Association (VVCIA), P.O. Box 385, Victorville, CA 92392

Elf Brigade Swipe Swap, P.O. Box 173, Red Bluff, CA 96080

COLORADO

Western Slope Commodore User's Group, P.O. Box 4142, Grand Junction, CO 81502

CONNECTICUT

The New London County Commodore User's Group (NLCCUG), P.O. Box 697, Groton, CT 06340

Questers of America, 10 Pink Cloud Ln., Weston, CT 06883-2702

DELAWARE

The Commodore U.S.A. Club, Rt. 2, Box 329, Delmar, DE 19940

FLORIDA

Commodore Connection Computer Club, Inc., P.O. Box 6684, West Palm Beach, FL 33405

Mana Sota Commodore Users Group (MSCUG), 916 E. 35th Dr., Bradenton, FL 34208

Ram Rom 84 Commodore Users Group, P.O. Box 3880, Venice, FL 34293

Suncoast Commodore Club, P.O. Box 6628, Ozona, FL 34650-6628

ILLINOIS

Fox Valley 64 Users Group, P.O. Box 28, North Aurora, IL 60542

Commodore 64/128 Computer Pen Pal Club!, P.O. Box 192, Georgetown, IL 61846

INDIANA

Rochester Commodore Computer Club, 428 Clay St., Rochester, IN 46975

IOWA

Quad Cities Commodore Computer Club, P.O. Box 3994, Davenport, IA 52808

KANSAS

High Plains Commodore Users Group, 1307 Western Plains, Hays, KS 67601

KENTUCKY

Louisville Users of Commodore of Kentucky (L.U.C.K.Y., Inc.), P.O. Box 19032, Louisville, KY 40219-0032

Muhlenberg County Commodore Users Group (M.C.C.U.G.), P.O. Box 12, Greenville, KY 42345

LOUISIANA

Sixty Four'Um Commodore User's Group, P.O. Box 6481, Metairie, LA 70009-6481

MASSACHUSETTS

USA SX-64 Users Group, 10 Cornwall St., Boston, MA 02130

MISSOURI

McDonnell Douglas Commodore Users Group, c/o Bruce Darrough, 28 Redwood, Florissant, MO 63031

Columbia Commodore User (CCU), P.O. Box 7633, Columbia, MO 65205

NEBRASKA

McCook Commodore Users Group, 1010 East 2nd St., McCook, NE 69001

NEW YORK

Commodore User Group of Westchester, P.O. Box 1280, White Plains, NY 10602

Catskill Commodore Users Group, Box 160 RFD, Woodbourne, NY 12788

TEXAS

Saturday Morning Users Group (S.M.U.G.), P.O. Box 721357, Corpus Christi, TX 78472-1357

Amistad Commodore Users Group, P.O. Box 421212, Del Rio, TX 78842

El Paso Commodore User Group, P.O. Box 370934, El Paso, TX 79904

VIRGINIA

CURVE, P.O. Box 28284, Richmond, VA 23228 (BBS# 804-288-1439)

WASHINGTON

Tacoma Area Commodore Users' Group (TACUG), P.O. Box 9191, Tacoma, WA 98409 (BBS# 206-475-8084)

WISCONSIN

Milwaukee Area Commodore Enthusiasts (M.A.C.E.), P.O. Box 26216, Milwaukee, WI 53226

Yorkiesoft Inc., 100 Arrowhead Dr., Green Bay, WI 54301

Outside the U.S.

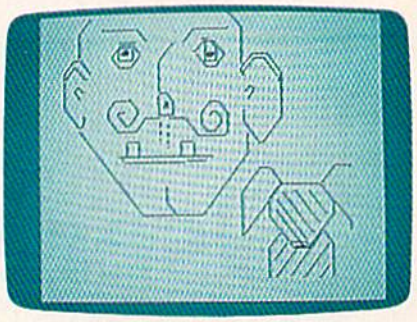
CANADA

Beaver Valley Commodore Club, Box 495, Montrose, British Columbia, Canada V0G 1P0

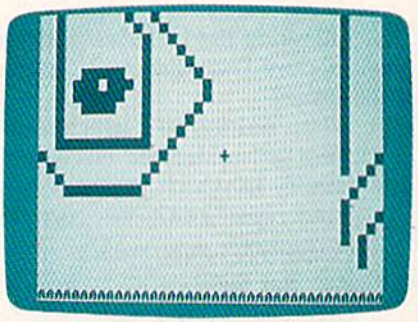
Saskatoon Commodore Users Group, P.O. Box 7831, Saskatoon, Saskatchewan, Canada S7K 4R5

Zoom

Robert Bixby



While "Zoom" allows you to draw freehand in hi-res, it really shines in detailed touch-up for your art.



With a single keystroke, "Zoom" drops into magnify mode, giving you complete control over every pixel.

You never had this much control over details in your hi-res screens. "Zoom" magnifies any specified area by a factor of 64 and then makes pixel editing easy. Versions for both the Commodore 64 and 128 are included. Joystick required.

Perfecting a hi-res screen takes quite a bit of work. Proportions need to be just right. Shading has to be appropriate. Details must be rendered accurately. In the process of turning an acceptable picture into a masterpiece, a zoom mode is essential. "Zoom" adds such a mode. With Zoom, you can magnify any area of the screen by a factor of 64.

With Zoom in your toolkit, graphics creation becomes much more flexible. You can start a picture with a paint program that lacks a zoom function, then move over to Zoom to add details and shading. You can even design and program your own paint program around Zoom. The program works with most hi-res screens, but color is not supported.

Or, if you don't own a paint program, you can use Zoom to modify pictures that you download from bulletin boards.

Typing It In

There are two versions of Zoom, one for the 64 and one for the 128. Both programs are written in machine language. Using the appropriate version of "MLX" for your computer, type in the data for Zoom. If you're typing in the 64 version, respond with the values indicated when MLX asks for the starting and ending addresses.

Starting address: C000
Ending address: C56F

After you've typed in all the data for Zoom, be sure to save a copy to disk.

If you're typing in the 128 version, respond with the values listed below.

Starting address: 1300
Ending address: 175F

Save a copy before exiting MLX.

The Big Picture

To use Zoom, load the program with a statement of the form LOAD "ZOOM",8,1. Then type SYS 49152 to start Zoom. On the 128, type BLOAD"ZOOM" and then SYS 4864.

When Zoom starts, you'll see the hi-res screen located at memory location 8192. You can draw on the screen by holding down the fire button and moving the pixel cursor with the joystick.

When you're ready to go to zoom mode, move the pixel cursor to the area of the screen that you would like to magnify and press Z. The region surrounding the cursor is magnified. The cursor now appears as a cross character. Move the cursor with the joystick. To place a dot at the position of the cursor, press the period key. To remove a pixel, press the comma key.

To see the entire screen again, press RETURN. You can now move the cursor to another position on the screen that you wish to magnify.

The 64 version of Zoom includes two file commands. Press L to load a screen. You'll be prompted for a filename. To save a picture, press the S key. Then enter the filename with which you wish to save the picture.

Because BASIC 7.0 has BLOAD and BSAVE commands, the save and load commands are not implemented in the 128 version of Zoom. To load a screen and clear hi-res color memory (do this from BASIC, before typing SYS 4864), enter a statement of the form:

```
GRAPHIC 1,1:BLOAD"filename",P8192:
  GRAPHIC 0
```

Now perform the SYS command to go to Zoom.

To exit Zoom and return to BASIC, press Q on the 64 or ESC on the 128. You'll be in hi-res mode. On the 64, carefully type SYS 49156 (you won't be able to see what you're typing) to return to the text screen. On the 128, type GRAPHIC 0,1.

If you're using the 128 version of Zoom, you can now save your screen with the BSAVE command. Type the following:

```
BSAVE"filename",P8192 TO P16384
```

In either version of the program, you are free to move back and forth from BASIC to Zoom as many times as you like.

Note that both versions of Zoom assume that pictures loaded into the program will consist only of hi-res pixel data.

See program listings on page 74.

3-D Sprites

Hubert Cross

Design and animate high-resolution sprites on your Commodore 64 with "3-D Sprites." Since the program adds new BASIC commands, even beginning programmers can get excellent results.

Turn on your television and you'll see a deluge of computer graphics. Perhaps it's a local station's news logo, a baseball that flies up impossibly close to the television camera before dissolving, or an automobile that magically assembles itself from its component parts.

The systems that create these graphics cost hundreds of thousands of dollars. Your Commodore 64 can't match these effects, but you may be surprised to find out just what it can do with "3-D Sprites," a powerful animation package that features a CAD-like object designer. Spinning spaceships, flying paper airplanes, and walking robots are but a few of the possible objects you can design.

Typing It In

3-D Sprites consists of two programs—a 5000-byte machine language program and a short BASIC program. The BASIC program is used to create data tables and code for the super-fast screen-copying subroutines that are an integral part of 3-D Sprites.

Using "MLX," the machine language entry program listed elsewhere in this issue, type in and save a copy of Program 1, the machine language portion of 3-D Sprites. When MLX prompts you for the starting and ending addresses of 3-D Sprites, enter the following values:

```
Starting address:  4000
Ending address:    53EF
```

Next, type in Program 2, the BASIC portion of 3-D Sprites. Since this program creates machine language code, it must be typed in accurately. Use "The Automatic Proofreader" when entering it. Be sure to save a copy of the program to tape or disk when you've finished.

To start the program, load Program 1 with a statement of the form LOAD"*filename*",8,1 (for disk) or LOAD"*filename*",1,1 (for tape). Be sure to use the filename that you used to save the program. Next, type NEW and then load and run the BASIC part of the program. Activate 3-D Sprites by typing SYS 16384. You now have 14 new BASIC commands available for designing and animating 3-D objects.

Designing Sprites

The objects in 3-D Sprites have no relationship to the 64's hardware sprites. Instead, they are high-speed, 3-D wire-frame software sprites. It's convenient to think of them as sprites, but don't confuse them with the 64's built-in sprites.

The first command that you should try is DESIGN. This command is a full-featured object designer. To enter DESIGN mode, you must provide the number of the object you want to create. The range is 1–255. Objects can be designed in any order; you can DESIGN object 147 even if you have not yet created objects 1–146 yet.

For now, type DESIGN 1. A 3-D Cartesian coordinate system (with axes that indicate the *x*, *y*, and *z* dimensions) appears with a blinking pixel-sized cursor in the center position. Use a joystick (plugged into port 2) to move the cursor rapidly. The cursor keys move it more slowly. At the bottom of the screen, you'll see the values of the coordinates. Also displayed are the angles of rotation around each axis. Note that these angles are not given in the normal degrees or radians, but rather are in "computer degrees"—256 of which make up a circle. The center of the object is located at position 0,0,0. You can move there in one step by pressing the HOME key. The maximum value along any axis is 63; the minimum is −64. As you draw, you normally move in the *x,y* plane. To change the *z* position, press the Z key (the letter Z appears near the bottom of the screen). Move the joystick up and down to move the cursor rapidly. Use the up and down cursor keys to move it more slowly. To return to movement in the *x,y* plane, press Z again.

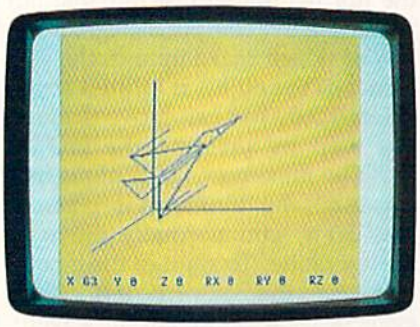
Objects are built from lines. To draw a line, place the cursor at the starting point. Press the fire button or the space bar, and an "elastic" line appears. Now move to the endpoint of the line and press RETURN to set it down. If you wish to make a sequence of connected lines, press the fire button or the space bar at the endpoint of each line and then press RETURN at the end of the sequence. Although the objects are black while you edit, you'll be able to change the color later when you display the object.

As you design your object, you'll probably want to see what it looks like from different angles. Rotate it with the function keys. Press f1 to rotate around the *x*-axis, f3 for the *y*-axis, and f5 for the *z*-axis. Press f2, f4, and f6 to decrement the angles, or f7 to reset them all to 0. Note again that the program does not use a normal scale (256 computer degrees = 360 normal degrees).

When you rotate your object, you lose any line still elastic. You can add lines to a rotated object, but it's more accurate to set all angles back to 0 before drawing.

While designing objects, you'll

find that it's convenient to be able to go to a point that you've already used. Press the S key to do this. With each press of the key, you'll move to another endpoint that you have placed previously. To draw a line between two existing vertices, press S repeatedly until the cursor moves to one of the vertices; then press fire and then S again, until the elastic line stretches to the other vertex. This considerably shortens the process of sprite design. It also ensures that the lines join at exactly the same point.



"3-D Sprites" features an easy-to-use three-dimensional editor. A jet fighter is being constructed here.

When using the select (S-key) option on a rotated object, the cursor may land on a point outside the normal range (−64 to 63). If this happens, you won't be able to move the cursor with the joystick. Instead, press S again or press the HOME key.

When you rotate an object, it rotates around the HOME position. You may center your object at any time by pressing the C key. Note that the centering process is irreversible.

If you are designing an object and want to start over, press the CLEAR key. You'll be prompted with *ERASE ALL ARE YOU SURE? (Y/N).*

Using the DELETE key is less drastic. It erases lines one at a time, beginning with the most recently drawn one.

You may get two error messages while in DESIGN mode. These errors are displayed at the bottom of the screen. The first is *ONLY 255 LINES ALLOWED*, which lets you know that you have reached the maximum number of lines per object. The other is *OUT OF MEMORY*, which tells you that you've run out of object storage space. These error messages should be very rare.

To leave design mode, press STOP. You'll return to BASIC. You may repeatedly move in and out of DESIGN mode without harm. (Only elastic lines are lost). In fact, if you're designing a very intricate object, it is helpful to exit to BASIC often to preview the object with the DISPLAY command (described later).

Back in BASIC

The function keys have different roles in BASIC mode. If you press f3, hi-res screen 1 is displayed. Press f5 to see screen 2. (DESIGN mode clears both screens.) Press f1 to return to the BASIC text screen. You can press the function keys to peek at other screens whenever you want, even when a program is running. *But be sure not to press them while loading or saving.* This could cause the load or save to fail.

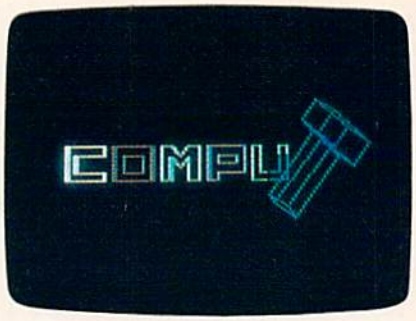
Besides the two normal high-resolution screens, 3-D Sprites has a third high-resolution screen which cannot be displayed directly. This third screen allows you to COPY your objects or drawings to the "background." Once you have copied something to the background, it will not be erased even as objects are moved over it. See the command COPY below.

Displaying Objects

Once you have created a 3-D sprite, you can enable it with the command DISPLAY. All the parameters listed below are required. The object may appear completely on the screen, partially off the screen, or it may be located completely off the screen. It may also appear as a single dot if you place it too far away. Here is the syntax for DISPLAY and a list of its parameters:

DISPLAY *(n,sc,c,b,rx,ry,rz,x,y,z)*

parameter	description	range
n	object number	(1 to 255)
sc	scale	(0 to 255)
c	object color	(0 to 15)
b	bit pair	(0 to 3)
rx	*x* rotation	(−32768 to 32767)
ry	*y* rotation	(−32768 to 32767)
rz	*z* rotation	(−32768 to 32767)
x	*x* translation	(−32768 to 32767)
y	*y* translation	(−32768 to 32767)
z	*z* translation	(0 to 32767)



Use the sprites in your own programs. In this demo, the letters in COMPUTE! spin into place.

After creating object 1, try this command in immediate mode:

```
DISPLAY 1,1,1,1,0,0,0,0,0,0
```

After viewing the object, press f1 to return to the text screen.

If you fail to type all 10 parameters, you'll receive a syntax error. If you try to display an object that doesn't contain any lines, you'll see this error message: *?UNDEF'D SPRITE ERROR.* An object must have at least one line to be considered defined.

The best way to animate an object is with a FOR-NEXT loop. This loop will move a spaceship from the border of the screen to deep into outer space:

```
1000 SETCOLOR 0,0
1010 FOR X=0TO5000STEP50
1020 DISPLAY 1,1,1,1,0,10,0,100,−20,X
1030 FLIP:NEXT:SETCOLOR14,6:
     LOWRES
```

The object is painted in white, using bit pair 1. The bit pair used is important. If you use bit pair 0 (binary 00), the object is drawn in the transparent color. If you use bit pair 3 (binary 11), it will be painted the same color your characters were when you were in text mode (the color number will be ignored). If you choose bit pair 1 (binary 01) or 2 (binary 10), it will be painted with the color you specify.

Due to the 64's hardware limitations, the object changes the color of every character cell it touches; that is, everything in that cell which is painted with the same bit pair will change color. The effect is temporary, and everything will return to its previous color when your object moves off the cell. It is up to you to see that this color conflict does not occur.

The other parameters are self-explanatory, but there are two details which should be mentioned: First, when you use DESIGN, the

positive z-axis is facing toward the screen. But when you use DISPLAY, it faces the other way. The other oddity is that you can specify positive or negative values for *x* and *y*, but *z* accepts only positive values.

Unlike hardware sprites, you can display the same 3-D Sprite object at many different places at the same time.

Other Commands

The DRAW command allows you to draw lines on the screen. Here is the syntax for the command:

DRAW *(color,bitpair,X1,Y1,X2,Y2)*

The range for the coordinates is −32768 to 32767. The program will DRAW only the part of the line that is visible.

The COPY command copies the screen that is being displayed to the background screen. This command is ignored if you're in low-resolution mode. The best way to use this command (to make sure you're copying the screen that actually has your paintings and not the other one) is to always put it after FLIP. What you COPY to the background will remain there until you ERASE it or until you enter DESIGN mode, which uses the three screens for its own purposes. COPY can be used repeatedly without harm. By using it with DISPLAY and FLIP, you can produce an animation that stamps itself to the background every now and then.

The FLIP command allows you to animate your 3-D Sprite objects. FLIP displays one screen and directs what you're drawing to the other. FLIP automatically erases the old screen by copying the background screen to it.

The ERASE command clears all three screens: the two drawing screens, and the background screen.

The SETCOLOR command changes the screen colors you're using. SETCOLOR *(border, background, bitpair 3, viewer-screen distance)* changes the border, background, and bit pair 3 (binary 11) colors.

The last parameter in the SETCOLOR command has nothing to do with colors. It's a constant you can set to affect the drawing of all objects. This value is set to 256 when you type SYS16384. You shouldn't change it until you're very familiar with the program. If you reduce this parameter, objects will become smaller and will become very distorted when close to the screen. If you change it to a very large value (like 30000), you'll have very little z-axis room for your objects, and you could get *?OVERFLOW ERROR*s very often.

The LOWRES command flips to the text screen.

The CLEAR command clears the sprite object database. You'll be asked if you're sure you want to do this.

The MEMORY command prints the number of bytes left in the object database. If you think you may be getting close to the limit, you can type MEMORY to see how many bytes are left.

To save and load your 3-D Sprite objects, four commands are included: DSAVE *"filename"*, DLOAD *"filename"*, CSAVE, and CLOAD. DSAVE and DLOAD are for disk, and CSAVE and CLOAD are for tape. These commands save and load all the objects currently stored in the database.

Always try to visualize what you're doing. In a typical 13-inch TV set, each pixel is about 1.4 millimeters long; thus, 65536 pixels are 65536*1.4 millimeters, or about 92 meters. So, the imaginary space for your objects is a "box" measuring 92 × 92 × 46 meters. (Remember that the z coordinate is only 32767 pixels long). A sprite with a scale factor of 1 is only 128 × 128 × 128 pixels at the most; that is only about 18 × 18 × 18 centimeters. Try to visualize that box and imagine your TV as a small "window" on the box. How deep inside the box is your object; how many meters (or pixels) to the left or right and how many up or down is it? Will you be able to see it from the window? When you visualize it this way, it becomes easy to create *Flight-Simulator*-like, 3-D landscapes. Choose a fixed *y* value for the ground (you can even paint the ground solid with a loop using DRAW) and start placing your objects by choosing their appropriate *x*- and *z*-coordinates.

3-D Sprites, Memory, and Errors

3-D Sprites moves the top of BASIC to $4000. The memory from $4000 up is used for storing the code, lookup tables, object data, working space, and the three high-resolution screens with its three associated color screens. Here's a memory map:

$4000–$53EF	Program code
$5400–$5701	Plotting lookup tables
$5702–$5AC1	Screen-copying code
$5AC2–$5B02	Sines lookup table
$5B03–$7CFF	Object database
$7D00–$87FF	Working area for rotating, translating, and projecting vertices
$8800–$8BFF	Color for hi-res screen 1
$8C00–$8FFF	Color for background hi-res screen
$9000–$9FFF	First half of background hi-res screen
$A000–$BF3F	Hi-res screen 1
$BF80–$BFBF	Hardware sprite (blinking dot minicursor)
$C000–$C7ED	Free for utilities (such as, "TurboDisk")
$C7EE–$C7FF	Nonzero page variables
$C800–$CBFF	Color for hi-res screen 2
$CC00–$CFFF	Free space for "DOS Wedge"
$D000–$DFFF	Second half of background hi-res screen
$E000–$FF3F	Hi-res screen 2
$FF80–$FFBF	Hardware sprite (blinking dot minicursor)
$FFFA–$FFFB	ROM-disabled NMI vector
$FFFE–$FFFF	ROM-disabled IRQ vector

3-D Sprites is not compatible with programs that open files to cassette or with programs that use RS-232 files.

While you're using 3-D Sprites, you may encounter any of the following error messages:

?ILLEGAL QUANTITY ERROR
One or more parameters are outside the legal range of values.

?UNDEF'D SPRITE ERROR
You're trying to display an object that does not exist. (Entering DESIGN mode does not necessarily create an object. An object has to have at least one line to be considered defined.)

?OVERFLOW ERROR
If you get this error, you can usually assume that it doesn't come from BASIC, which can handle very large numbers, but from 3-D Sprites. Whenever any of your values for the DISPLAY parameters cause the program's 16/32 bit math to overflow, you'll get this error message. This usually happens if your scale value in the DISPLAY command or your viewer-screen distance in the SETCOLOR command is too large.

3-D Sprites is compatible with TurboDisk and with the DOS Wedge.

See program listings on page 79.

BEFORE TYPING . . .

Before typing in programs, please refer to "How to Type In COMPUTE!'s GAZETTE Programs," elsewhere in this issue.

RAM Expander 64

Article on page 60.

```
HE 10 REM COPYRIGHT 1988 COMPU
      TE! PUBLICATIONS, INC. -
       ALL RIGHTS RESERVED
RH 20 PRINT"{CLR}{3 SPACES}COP
      YRIGHT 1988 COMPUTE! PUB
      ., INC."
CA 30 PRINTTAB(11)"ALL RIGHTS
      {SPACE}RESERVED"
RP 40 PRINT"{DOWN}START ADDRES
      S ? 49152{7 LEFT}";:INPU
      TX$:A=VAL(X$)
CX 50 FORI=ATOA+208:READX:CK=C
      K+X:POKEI,X:NEXT
CP 60 IFCK<>23132THENPRINT"
      {DOWN}ERROR IN DATA STAT
      EMENTS.":STOP
CA 70 B=A+11:X=INT(B/256):Y=B-
      X*256
KB 80 POKEA+1,Y:POKEA+3,X
DH 90 B=A+184:X=INT(B/256):Y=B
      -X*256
MB 100 POKEA+45,Y:POKEA+46,X
CB 110 POKEA+63,Y:POKEA+64,X
GJ 120 SYSA:END
BC 130 DATA 169,11,160,192,141
       ,8
XH 140 DATA 3,140,9,3,96,32
HG 150 DATA 115,0,201,33,240,6
BA 160 DATA 32,121,0,76,231,16
       7
JJ 170 DATA 32,115,0,165,122,1
       33
DJ 180 DATA 250,165,123,133,25
       1,160
BG 190 DATA 0,162,0,32,121,0
BD 200 DATA 133,2,185,184,192,
       240
CQ 210 DATA 38,197,2,208,9,32
JE 220 DATA 115,0,133,2,200,24
FC 230 DATA 144,238,185,184,19
       2,240
HF 240 DATA 3,200,208,248,200,
       165
SG 250 DATA 250,133,122,165,25
       1,133
ED 260 DATA 123,232,224,4,144,
       211
JX 270 DATA 76,8,175,134,2,32
RB 280 DATA 138,173,32,247,183
       ,140
FB 290 DATA 7,223,141,8,223,32
JX 300 DATA 253,174,32,138,173
       ,32
PS 310 DATA 247,183,140,2,223,
       141
GX 320 DATA 3,223,32,253,174,3
       2
EC 330 DATA 138,173,32,247,183
       ,140
SG 340 DATA 4,223,141,5,223,32
EP 350 DATA 253,174,32,138,173
       ,32
QP 360 DATA 247,183,140,6,223,
       165
MX 370 DATA 1,41,254,133,1,165
JF 380 DATA 2,24,105,144,141,1
AX 390 DATA 223,165,1,9,1,133
GM 400 DATA 1,165,2,201,3,208
MH 410 DATA 12,173,0,223,41,32
QX 420 DATA 240,5,162,28,108,0
EX 430 DATA 3,76,174,167,83,84
JE 440 DATA 65,83,72,0,70,69
CR 450 DATA 84,67,72,0,83,87
GG 460 DATA 65,80,0,67,79,77
EJ 470 DATA 80,65,82,69,0
```

Investor

Article on page 36

```
HE 10 REM COPYRIGHT 1988 COMPUT
      E! PUBLICATIONS, INC. - A
      LL RIGHTS RESERVED
PS 20 R=53280:S=R+1:H=646
SP 30 IF PEEK(65530)=164 THEN R
      =65305:S=65301:H=1339
PA 40 IFPEEK(65530)=5THEN={B}15
      :H=241
JA 50 T=11:M1=1000:M2=1000:TI$=
      "000000":X=RND(-TI)
MD 60 POKER,0:POKES,0:POKEH,3:P
      RINT"{CLR}"
SK 70 PRINTTAB(15)"INVESTOR
      {2 DOWN}":PRINTTAB(12)"CO
      PYRIGHT 1988"
BX 80 PRINTTAB(7)"COMPUTE! PUBL
      ICATIONS, INC."
CQ 90 PRINTTAB(10)"ALL RIGHTS R
      ESERVED":FORTT=1 TO 2000:
      NEXT
FX 100 PRINT"{CLR}{3 DOWN}"TAB(
       5)"NUMBER OF PLAYERS (1
       {SPACE}OR 2)? ";
MD 110 GETA$:IFVAL(A$)< 1 OR VA
       L(A$)>2 THEN 110
SS 120 PRINTA$:FOR D=1 TO 750:N
       EXT
JQ 130 FOR P=1 TO VAL(A$)
QH 140 PRINT"{CLR}{3 DOWN}"TAB(
       9)"PLAYER"P"NAME ";
PQ 150 INPUTP$(P):P$(P)=LEFT$(P
       $(P),7):IFP$(P)=""THEN15
       0
CP 160 NEXT
FH 170 PRINT"{CLR}{2 DOWN}"TAB(
       6)"ENTER TIME LIMIT:
       {RVS}S{OFF}HORT"
FG 180 PRINTTAB(24)"{RVS}M{OFF}
       EDIUM"
JE 190 PRINTTAB(24)"{RVS}L{OFF}
       ONG":PRINTTAB(15);
HA 200 GET T$:IFT$=""THEN200
HJ 210 IFT$="S"THEN TM=3000:GOT
       O250
QD 220 IFT$="M"THEN TM=5500:GOT
       O250
FF 230 IFT$="L"THEN TM=8000:GOT
       O250
QA 240 GOTO200
DK 250 FORX=BTO100:NEXT
HG 260 PRINT"{CLR}{HOME}{CYN}":
       PRINT"O";:FORX=0TO36:PRI
       NT"{Y}";:NEXT:PRINT"P"
CM 270 PRINT"{HOME}{DOWN}":FORB
       =0TO20:PRINT"{H}":NEXT
RB 280 PRINT"L";:FORB=0TO36:PRI
       NT"{P}";:NEXT:PRINT"@
       {LEFT}{UP}";:FORB=0TO20:
       PRINT"{N}{LEFT}{UP}";
JX 290 NEXT:IFFL=1THEN310
BS 300 DIMS$(11),COL(11):FORX=1
       TO11:READS$(X):NEXT:FORX
       =1TO11:READCOL(X):NEXT
SX 310 PRINT"{HOME}{2 DOWN}
       {2 RIGHT}{YEL} FUNDS
       {6 SPACES}":PRINT"{CYN}
       {2 RIGHT}{34 SPACES}"
RG 320 FORX=1TO11
JX 330 POKEH,COL(X):PRINT"
       {2 RIGHT}"S$(X):NEXT
PH 340 IF TM<0 THEN TM=0
CP 350 PRINT"{HOME}{CYN}";:PRIN
       TTAB(16)"{RVS}"TM"{OFF}"
BD 360 PRINT"{HOME}{2 DOWN}
       {YEL}";:PRINTTAB(13)"COS
       T{3 SPACES}AT{3 SPACES}H
       I{2 SPACES}LOW{2 SPACES}
       DIV{DOWN}"
KM 370 FORX=1TO11
EE 380 PRINT"{DOWN}";:NEXT
DA 390 PRINT"{YEL}{DOWN}"TAB(4)
       "{RVS}{8 SPACES}CASH RES
       ERVES{9 SPACES}{OFF}"
RK 400 IFVAL(A$)=1THENPRINT"
       {DOWN}{4 RIGHT}{RVS}"P$(
       1)"{OFF}":GOTO420
AP 410 PRINT"{DOWN}{4 RIGHT}
       {RVS}"P$(1):PRINT"{DOWN}
       {4 RIGHT}{RVS}"P$(2)"
       {OFF}"
HC 420 PRINT"{HOME}{3 DOWN}":IF
       FL=1THEN480
MA 430 DIMA(T),B(T),C(T),CC(T),
       D(T),J(T),P1(T),P2(T)
SQ 440 FORT=1TO11
GR 450 A(T)=100:B(T)=0:C(T)=100
       :CC(T)=100:D(T)=0:P1(T)=
       0:P2(T)=0
XP 460 PRINT"{CYN}"TAB(13)A(T)"
       {2 RIGHT}"B(T)C(T)CC(T):
       NEXT
KG 470 FL=1
PF 480 PRINT"{HOME}";:FORB=1TO1
       8:PRINT"{DOWN}";:NEXT:FO
       RB=1TO12:PRINTTAB(12)"
       {GRN}$"M1
KG 490 IFVAL(A$)=2 THEN PRINT"
       {DOWN}"TAB(12)"$"M2
AJ 500 REM *MAIN ROUTINE*
PQ 510 X=INT(RND(1)*12)
XK 520 IF X=0 THEN 510
CJ 530 Y=INT(RND(1)*6)
FM 540 IFY=0THEN530
MH 550 PRINT"{HOME}{CYN}":Z=X+2
RF 560 FORQ=1TOZ:PRINT"{DOWN}";
       :NEXT
PA 570 SI=INT(RND(1)*4):IF SI=0
        OR SI=2THENSI=-1:GOTO59
       0
XX 580 SI=1
GS 590 J(X)=A(X):K=C(X):A(X)=A(
       X)+Y*SI:B(X)=B(X)+Y*SI:D
       (X)=Y
EJ 600 PRINT"{CYN}"TAB(13);:IFA
       (X)<=0ORA(X)>=200THENB(X
       )=0:C(X)=100:CC(X)=100
XG 610 IFA(X)<=0 THEN P1(X)=0:P
       2(X)=0:A(X)=100:D$="BRK
       {SPACE}":GOTO630
QR 620 IFA(X)>=200 THEN P1(X)=P
       1(X)*2:P2(X)=P2(X)*2:A(X
       )=100:D$="SPL "
QK 630 IFA(X)<100 THEN PRINT" "
       ;
MF 640 IFA(X)<10 THEN PRINT" ";
MH 650 PRINTA(X)"{4 SPACES}
       {4 LEFT}";
MJ 660 IFB(X)<0 THEN POKEH,2:GO
       TO680
ES 670 GOTO710
PA 680 IFB(X)>=-9 THEN PRINT"
       {2 SPACES}";:GOTO730
GA 690 IFB(X)>=-99 THEN PRINT"
       {SPACE}";?:GOTO730
SB 700 GOTO730
CF 710 IFB(X)<10 THEN PRINT"
       {2 SPACES}";:GOTO730
SH 720 IFB(X)<100 THEN PRINT" "
       ;
HX 730 PRINTB(X);
HA 740 IFA(X)>C(X) THEN C(X)=A(
       X)
KF 750 POKEH,3:PRINTC(X);
HR 760 IFA(X)<CC(X) THEN CC(X)=
       A(X)
HX 770 IFCC(X)<10 THEN PRINT"
       {2 SPACES}";:GOTO800
```

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```
HF 780 IFCC(X)=100 THEN 800
KF 790 PRINT" ";
HM 800 PRINTCC(X);
JG 810 IFB(X)<0 THEN PR=.005*A(
       X):GOTO850
DC 820 PR=INT(Y*.01*A(X))
MM 821 IF D$="SPL " THEN PRINT"
       {RIGHT}{GRN}";D$;:D$="":
       FOR B=1 TO 500:NEXT:GOTO
       840
PK 822 IF D$="BRK " THEN PRINT"
       {RIGHT}{RED}";D$;:D$="":
       FOR B=1 TO 500:NEXT:GOTO
       840
PK 830 PRINT"{RIGHT}%"D(X);:FOR
       B=1TO200:NEXT
HC 840 PRINT"{4 LEFT}{3 SPACES}
       "
GK 850 IFP1(X)>0 THEN M1=M1+INT
       (PR*P1(X))
XX 860 IFP2(X)>0 THEN M2=M2+INT
       (PR*P2(X))
EQ 870 PRINT"{HOME}";:FORB=1TO1
       8:PRINT"{DOWN}";:NEXT:FO
       RB=1TO12:PRINTTAB(12)"
       {GRN}$"M1
HX 880 IFVAL(A$)=2THENPRINT"
       {DOWN}"TAB(12)"$"M2
KE 890 GETI$:IFI$=" "THEN930
RP 900 GOSUB1570:PRINT"{HOME}"T
       AB(16)"{RVS}{CYN}"TM"
       {OFF}{LEFT}{3 SPACES}"
JP 910 IFTM=0THEN1610
SR 920 GOTO510
XH 930 INPUT"{CLR}{HOME}
       {3 DOWN}{3 RIGHT}{CYN}EN
       TER NAME OF PLAYER ";V$:
       V$=LEFT$(V$,7)
MK 940 IFV$=P$(1) THEN PL=1:MO=
       M1:GOTO980
CC 950 IFV$=P$(2) THEN PL=2:MO=
       M2:GOTO980
CS 960 PRINT"{DOWN}{3 RIGHT}
       {RVS}"V$"{OFF} IS NOT A
       {SPACE}PLAYER."
HC 970 FOR PA=1TO1000:NEXT:GOTO
       930
FE 980 PRINT"{CLR}{HOME}{CYN}":
       PRINT"O";:FORX=0TO36:PRI
       NT"{Y}";:NEXT:PRINT"P"
RA 990 PRINT"{HOME}{DOWN}":FORX
       =0 TO 12:PRINT"{H}":NEXT
RR 1000 PRINT"L";:FORX=0 TO 36:
        PRINT"{P}";:NEXT:PRINT"
        @{LEFT}{UP}";:FORX=0 TO
        12:PRINT"{N}{LEFT}{UP}
        ";
CD 1010 NEXT:PRINT"{HOME}{RVS}"
        TAB(12)V$"{OFF}
        {2 SPACES}{GRN}$"MO
AR 1020 PRINT"{2 RIGHT}{DOWN}
        {RVS}{YEL}{2 SPACES}FUN
        DS{10 SPACES}QTY
        {8 SPACES}VALUE
        {2 SPACES}{OFF}{DOWN}"
GJ 1030 FORU=1 TO 11
EP 1040 POKEH,COL(U):PRINT"
        {3 RIGHT}"S$(U):NEXT
EP 1050 PRINT"{HOME}{3 DOWN}"
        {21 SPACES}
KG 1060 IFPL=2THEN1130
MP 1070 X$="{5 LEFT}":FORX=1TO1
        1
QR 1080 PRINT"{CYN}"TAB(19);
RD 1090 PRINT LEFT$(X$,LEN(STR$
        (P1(X)))-2)P1(X);
GD 1100 IFA(X)<10 THEN PRINT"
        {2 SPACES}";:GOTO1120
MF 1110 IFA(X)<100 THEN PRINT"
        {SPACE}";
AK 1120 PRINTTAB(30)A(X):NEXT:G
        OTO1200
KA 1130 FORX=1TO11
JH 1140 X$="{5 LEFT}":FORX=1TO1
        1
CB 1150 PRINT"{CYN}"TAB(19);
BP 1160 PRINTLEFT$(X$,LEN(STR$(
        P2(X)))-2)P2(X);
EQ 1170 IFA(X)<100 THEN PRINT"
        {SPACE}";:GOTO1190
SP 1180 IFA(X)<10 THEN PRINT"
        {2 SPACES}";
GH 1190 PRINTTAB(30);A(X):NEXT
AC 1200 PRINT"{2 DOWN}{5 RIGHT}
        DO YOU WISH TO {RVS}B
        {OFF}UY OR {RVS}S{OFF}E
        LL?";
GX 1210 GETT$:IFT$="" THEN 1210
BM 1220 IFT$="S"ORT$="B" THEN 1
        250
HG 1230 IFT$=" "THEN TM=TM-30:G
        OTO260
EQ 1240 GOTO 1210
QR 1250 PRINT:PRINT"?{UP}
        {2 RIGHT}{30 SPACES}"
XS 1260 INPUT"{UP}{3 RIGHT}ENTE
        R FUND";ST$
EK 1270 FOR X=1 TO 11:IFST$=S$(
        X)THEN1330
GC 1280 NEXT
MP 1290 PRINT"{3 RIGHT}"ST$" IS
         NOT A FUND."
DX 1300 FORB=1TO1000:NEXT:PRINT
        "{2 UP}{3 RIGHT}"
CF 1310 FORB=1TO2:PRINT"
        {36 SPACES}":NEXT
BP 1320 PRINT"{2 UP}";:GOTO1260
AD 1330 PRINT"{UP}{35 SPACES}"
DD 1340 IFT$="S"THEN1450
PM 1350 SL=INT(MO/A(X))
QC 1360 PRINT"{3 RIGHT}YOU MAY
        {SPACE}BUY A MAXIMUM OF
        "SL
QD 1370 INPUT"{DOWN}{3 RIGHT}HO
        W MANY DO YOU WANT";AM:
        IFAM<0 THEN PRINT:GOTO1
        410
KE 1380 IFAM>SL THEN PRINT"
        {3 RIGHT}YOU CAN'T BUY
        {SPACE}THAT MANY.":GOTO
        1400
XJ 1390 GOTO1420
FJ 1400 FORB=1TO 1000:NEXT:PRIN
        T"{UP}{36 SPACES}"
CC 1410 PRINT"{3 UP}";:GOTO1370
CQ 1420 IFPL=1 THEN P1(X)=P1(X)
        +AM:M1=M1-INT(AM*A(X)):
        GOTO940
JM 1430 P2(X)=P2(X)+AM:M2=M2-IN
        T(AM*A(X))
MP 1440 GOTO 940
RX 1450 INPUT"{3 RIGHT}HOW MANY
         TO SELL";SL$
SH 1460 IFPL=1 THEN AM=P1(X):GO
        TO1480
JB 1470 AM=P2(X)
JF 1480 SL=VAL(SL$):IFSL<0 THEN
         PRINT:GOTO1510
QM 1490 IFSL>AM THEN PRINT"
        {3 RIGHT}YOU DON'T HAVE
         THAT MANY.":GOTO1510
HB 1500 GOTO 1540
GK 1510 FORB=1TO1000:NEXT:PRINT
        "{2 UP}{3 RIGHT}";
EB 1520 FORB=1TO2:PRINT"
        {35 SPACES}":NEXT
DM 1530 PRINT"{2 UP}";:GOTO1450
CJ 1540 IFPL=1 THEN M1=M1+SL*A(
        X):P1(X)=P1(X)-SL:GOTO1
        560
KJ 1550 IFPL=2 THEN M2=M2+SL*A(
        X):P2(X)=P2(X)-SL
KD 1560 GOTO 940
HG 1570 TM=TM-1
AK 1580 IFTM=<0 THEN TM=0
AE 1590 RETURN
XE 1600 REM *** END OF GAME ***
XJ 1610 PRINT"{CLR}{HOME}{DOWN}
        {CYN}";:PRINTTAB(12)"MA
        RKET CLOSES{4 SPACES}"
GC 1620 FORX=1TO11
CD 1630 PA=PA+P1(X)*A(X)
RK 1640 NEXT
CR 1650 PRINT"{3 DOWN}"TAB(10)"
        FINAL{2 SPACES}STATISTI
        CS{2 DOWN}"
FR 1660 PRINT"{RIGHT}PLAYER
        {2 SPACES}CASH
        {5 SPACES}FUNDS
        {5 SPACES}NET WORTH"
FM 1670 PRINT"{RIGHT}{6 T}
        {2 SPACES}{4 T}
        {5 SPACES}{5 T}
        {5 SPACES}{9 T}{2 DOWN}
        "
KQ 1680 PRINT"{RIGHT}{RVS}"P$(1
        ):PRINT"{OFF}{UP}
        {9 RIGHT}$"M1"{CYN}"
QK 1690 PRINTSPC(18):PRINT"{UP}
        $"PA
DA 1700 T1=PA+M1
PJ 1710 PRINTSPC(28)"{UP}$"T1
PM 1720 IFVAL(A$)=2THENPRINT"
        {DOWN}{RIGHT}{RVS}"P$(2
        ):GOTO1740
HS 1730 GOTO 1810
GM 1740 FORX=1TO11
KM 1750 PB=PB+P2(X)*A(X)
QB 1760 NEXT
JQ 1770 PRINTSPC(9):PRINT"{UP}
        {CYN}$"M2
JH 1780 PRINTSPC(18)"{UP}$"PB
DP 1790 T2=PB+M2
PH 1800 PRINTSPC(28)"{UP}$"T2
JM 1810 PRINT"{5 DOWN}"TAB(11)"
        PLAY AGAIN? (Y/N)"
QG 1820 GETA$:IFA$="" THEN 1820
DA 1830 IFA$<>"Y" THEN END
KS 1840 RUN
BC 1850 DATA LEISURE,AEROSPACE,
        GOLD,ENERGY,AGRICULTURE
        ,TECHNOLOGY,AUTOMOTIVE
AR 1860 DATA MINERALS,CHEMICALS
        ,COMPUTERS,ELECTRONICS
FA 1870 DATA 2,6,7,3,9,11,8,12,
        4,1,14
```

Cribbage 128

See instructions in article on page 32 before typing in.

Program 1: Cribbage 128—Machine Language

```
1300:D8 18 A9 00 85 FE 85 FD FE
1308:8D A0 18 8D A1 18 8D A2 24
1310:18 8D A3 18 8D A4 18 A0 6B
1318:16 46 8A 66 89 90 16 18 65
1320:A2 00 B5 FA 7D A0 18 9D 3A
1328:A0 18 08 E8 E0 05 F0 04 35
1330:28 4C 22 13 28 18 06 FA 9B
1338:26 FB 26 FC 26 FD 26 FE 79
1340:88 D0 D6 60 A9 00 A2 00 52
1348:95 FA E8 E0 05 D0 F9 85 08
1350:89 85 8A 60 18 A9 00 8D E8
1358:5C 1A 8D 5F 1A 8D 5D 1A B6
1360:8D 76 1A 8D 77 1A 8D 78 BE
1368:1A 8D 79 1A 69 01 8D 64 9E
1370:1A 60 18 A9 06 EE 5D 1A 1A
1378:CD 5D 1A D0 1B AD 5C 1A 8F
1380:18 69 01 C9 05 F0 0C 8D 5B
1388:5C 1A 18 69 01 8D 5D 1A 10
1390:4C 98 13 A9 FF 8D 5F 1A 0F
1398:60 18 A0 00 8C 6F 1A A2 02
13A0:00 EC 5C 1A F0 15 EC 5D 42
13A8:1A F0 10 BD 50 1A 99 60 74
13B0:1A BD 56 1A 99 65 1A C8 1F
13B8:4C D3 13 8C 5E 1A AC 6F 49
13C0:1A BD 50 1A 99 69 1A BD 73
13C8:56 1A 99 6B 1A EE 6F 1A 10
13D0:AC 5E 1A 18 E8 E0 06 D0 51
13D8:C8 60 18 A0 04 A2 00 AD E0
13E0:64 1A 18 DD 50 1A D0 01 2E
13E8:88 18 E8 E0 06 D0 F3 8C 6C
13F0:6D 1A 60 18 A2 00 8A A8 B4
13F8:C8 BD 60 1A D9 60 1A D0 F5
```

```
1400:06 EE 6E 1A EE 6E 1A C8 84
1408:C0 05 D0 ED E8 E0 04 D0 6E
1410:E5 60 18 A2 00 BD 65 1A 4C
1418:E8 E0 04 F0 08 DD 65 1A 19
1420:F0 F3 4C 2E 14 18 AD 6E F4
1428:1A 69 04 8D 6E 1A 60 A2 50
1430:00 BD 60 1A 9D 80 1A E8 81
1438:E0 05 D0 F5 A0 00 A2 00 D5
1440:BD 80 1A DD 81 1A 30 0B 68
1448:48 BD 81 1A 9D 80 1A 68 61
1450:9D 81 1A E8 E0 04 D0 E8 1B
1458:C8 C0 05 D0 E1 60 AD 69 18
1460:1A 8D 73 1A AD 6A 1A 8D E1
1468:74 1A AD 64 1A 8D 75 1A 59
1470:60 18 A2 00 BD 73 1A DD F0
1478:74 1A D0 06 EE 7E 1A EE 70
1480:7E 1A E8 E0 02 D0 ED AD 76
1488:73 1A CD 75 1A D0 06 EE 11
1490:7E 1A EE 7E 1A 60 D0 DF 18
1498:18 AD 73 1A 6D 74 1A 6D 27
14A0:75 1A C9 0F D0 06 EE 7E 2F
14A8:1A EE 7E 1A 60 A0 00 A2 33
14B0:00 BD 73 1A DD 74 1A 30 7D
14B8:0B 48 BD 74 1A 9D 73 1A BF
14C0:68 9D 74 1A E8 E0 02 D0 54
14C8:E8 C8 C0 03 D0 E1 60 20 CE
14D0:AD 14 18 A2 00 BD 73 1A F9
14D8:69 01 DD 74 1A D0 0E E8 12
14E0:E0 02 D0 F1 AD 7E 1A 18 E6
14E8:69 03 8D 7E 1A 60 18 AD 50
14F0:6E 1A AE 7F 1A E0 00 D0 C9
14F8:0B 38 ED 7A 1A B0 02 A9 5B
1500:00 4C 08 15 18 6D 7E 1A 1D
1508:48 20 44 13 68 85 FA AD 15
1510:6D 1A 85 89 20 00 13 EA D2
1518:EA EA AD A0 18 18 6D 86 B4
1520:1A 6D 76 1A 8D 76 1A A9 47
1528:00 6D 77 1A 8D 77 1A 60 1D
1530:A2 00 8E 86 1A BD 60 1A 88
1538:C9 0B D0 03 EE 86 1A E8 03
1540:E0 04 D0 F1 60 A9 00 85 44
1548:FA 85 FB 85 FC 4C 5E 15 14
1550:18 A5 FC 69 01 85 FB 18 54
1558:A5 FB 69 01 85 FA 20 7A 64
1560:15 E6 FA A9 06 C5 FA D0 D6
1568:F5 E6 FB A9 05 C5 FB D0 69
1570:E6 E6 FC A9 04 C5 FC D0 04
1578:D7 60 A2 01 A9 00 E4 FA 1D
1580:F0 12 E4 FB F0 0E E4 FC 8A
1588:F0 0A 18 7D 7F 1A C9 0F 8F
1590:30 02 D0 0F E8 E0 06 D0 06
1598:E5 C9 0F D0 06 EE 6E 1A F9
15A0:EE 6E 1A 60 18 A2 00 BD 30
15A8:80 1A C9 0B 30 05 A9 0A 76
15B0:9D 80 1A E8 E0 05 D0 EF 48
15B8:60 A2 00 8E 6E 1A 8E 7E 1C
15C0:1A BD 60 1A 9D 80 1A E8 21
15C8:E0 05 D0 F5 60 A2 00 18 C3
15D0:BD 73 1A 7D 74 1A C9 0F 80
15D8:D0 06 EE 7E 1A EE 7E 1A 56
15E0:E8 E0 02 D0 EA 18 AD 73 8B
15E8:1A 6D 74 1A 6D 75 1A C9 EA
15F0:0F D0 06 EE 7E 1A EE 7E 3F
15F8:1A 18 AD 73 1A 6D 75 1A AE
1600:C9 0F D0 06 EE 7E 1A EE E3
1608:7E 1A 60 A2 00 BD 73 1A 28
1610:C9 0B 30 05 A9 0A 9D 73 5E
1618:1A E8 E0 03 D0 EF 60 20 FE
1620:B9 15 20 42 16 20 F3 13 C2
1628:20 A4 15 20 45 15 20 12 03
1630:14 60 20 5E 14 20 71 14 80
1638:20 CF 14 20 0B 16 20 CD AB
1640:15 60 20 3C 14 18 A2 00 1D
1648:8E 8A 1A A0 01 8C 72 1A E4
1650:BD 80 1A DD 81 1A D0 16 C8
1658:C8 C0 03 D0 06 CD 8A 1A 1D
1660:F0 01 C8 8D 8A 1A E8 E0 A6
1668:04 D0 E5 4C 82 16 18 69 52
1670:01 DD 81 1A D0 0B EE 72 69
1678:1A E8 E0 04 D0 D2 4C 82 35
1680:16 E8 AD 72 1A C9 03 30 FC
1688:0F AD 6E 1A 18 6D 72 1A 8C
1690:88 C0 00 D0 F7 8D 6E 1A 2B
1698:E0 04 D0 AF 60 18 D8 78 D8
16A0:20 54 13 8D 90 1A 20 72 CC
16A8:13 20 99 13 20 DA 13 20 7D
16B0:30 15 20 1F 16 20 32 16 DB
16B8:20 EE 14 18 EE 64 1A A9 9B
16C0:0E CD 64 1A D0 E3 18 AD 89
16C8:77 1A CD 79 1A 90 25 F0 D6
16D0:02 B0 09 18 AD 76 1A CD 16
16D8:78 1A 90 18 AD 5C 1A 8D FB
16E0:7A 1A AD 5D 1A 8D 7B 1A 74
16E8:AD 77 1A 8D 79 1A AD 76 EB
16F0:1A 8D 78 1A A9 00 8D 76 1D
16F8:1A 8D 77 1A 8D 64 1A EE 47
1700:64 1A 18 EE 90 1A A9 10 29
1708:CD 90 1A D0 99 58 60 A2 23
1710:01 8A 9D 00 1B E8 18 E0 A2
1718:35 D0 F6 60 78 A2 00 A9 F1
1720:00 8D 00 FF 85 FA 8A 48 27
1728:AD 06 DC 6D 07 DC 18 69 66
1730:01 29 0F 18 65 FA 18 C9 9D
1738:34 90 02 A9 34 85 FB A6 D5
1740:FA A9 34 38 E5 FB A8 E4 B5
1748:FB F0 0B E8 C8 BD 00 1B F8
1750:99 34 1B 4C 47 17 A5 FB 5E
1758:85 FA C9 34 D0 CA A2 34 AF
1760:BD 34 1B 9D 00 1B CA D0 8A
1768:F7 A9 00 85 FA 68 AA E8 0D
1770:D0 B4 58 60 78 A2 01 A0 36
1778:01 BD 00 1B 99 34 1B BD D9
1780:1A 1B 99 35 1B C8 C8 E8 7F
1788:E0 1B D0 ED A2 34 BD 34 7C
1790:1B 9D 00 1B CA D0 F7 58 47
1798:60 00 00 00 00 00 00 00 F6
```

Program 2: Cribbage 128—BASIC

```
HE 10 REM COPYRIGHT 1988 COMPUT
      E! PUBLICATIONS, INC. - A
      LL RIGHTS RESERVED
DE 20 GRAPHIC0:SLOW:PRINT"{CLR}
      {3 SPACES}COPYRIGHT 1988
      {SPACE}COMPUTE! PUB., INC
      ."
AQ 30 PRINTTAB(11)"ALL RIGHTS R
      ESERVED":BLOAD"CR128"
BR 40 TRAP4340
GQ 50 DIMN(13),S(13),N$(13),S$(
      13),O$(13),C$(13),PN(4),P
      S(4),PN$(4),PS$(4),PC$(4)
      ,PR(4)
GJ 60 PRINT"{CLR}":COLOR0,2:COL
      OR4,14:PRINTCHR$(11)
RQ 70 DEFFNV(X)=X-INT(X/10)*(X-
      10)
RA 80 GC=0:GP=0:PZ=0:CZ=0:BB$="
      ":BL=0:NN$=" A 2 3 4 5 6
      {SPACE}7 8 910 J Q K"
FF 90 C1=0:C2=0:C3=0:C4=0:H1=0:
      H2=0:H3=0:H4=0:HD=0:OV=0:
      SYS5903
BF 100 PRINT"{CLR}":RESTORE:FOR
      I=1TO8:SY=(I-1)*2+1:SX=(
      I-1)*4+2:GOSUB3850:GOSUB
      4070:NEXT
SX 110 IFBB$=""THENGOSUB2030
ED 120 GOSUB300:FORI=1TO5:SYS59
      16:NEXT
MQ 130 GOSUB300:GOSUB380:GOSUB4
      60
EF 140 CH=0:RH=0:PC=0:TC=0:PH=0
      :PP=0:TP=0:HD=HD+1
CC 150 IFCRTHENPOKE6783,255:ELS
      EPOKE6783,0
AD 160 GOSUB300:GOSUB350:GOSUB6
      00:GOSUB2370:GOSUB770:GO
      SUB1530:IFOVTHEN90
PM 170 PRINT"{CLR}":GOSUB1040:P
      OKE6756,N(13)
BK 180 IFCRTHENGOTO210
MG 190 GOSUB2440:IFOVTHEN90
FS 200 IFCRTHEN230
FH 210 GOSUB2640:IFOVTHEN90
CE 220 IFCRTHEN?190
PH 230 REM
MB 240 GOSUB2810:IFOVTHEN90
JC 250 GOSUB4110
SC 260 GOSUB3200
CR 270 CHAR1,10,23:PRINT"{BLU}
      {RVS}{3 SPACES}HIT A KEY
      {3 SPACES}"
BD 280 GETKEYA$
SM 290 CR=ABS(CR-1):GOTO140
AD 300 REM SHUFFLE CARDS
GR 310 CHAR1,10,23:PRINT"{YEL}S
      HUFFLING CARDS"
XQ 320 SYS5916:SYS6004
JP 330 FORI=1TO13:N(I)=PEEK(691
      2+I):S(I)=INT((N(I)-1)/1
      3)+1:N(I)=N(I)-(INT((N(I
      )-1)/13)*13):NEXT
HP 340 RETURN
PA 350 REM SUBROUTINE TO STORE
      {SPACE}VALUES INTO MEMOR
      Y
BD 360 FORI=0TO5:POKE(I+6736),N
      (I+1):POKE(I+6742),S(I+1
      ):NEXT
DR 370 RETURN
KH 380 REM CUT FOR DEAL
JQ 390 SYS5916
ER 400 FORI=1TO2:N(I)=PEEK(6912
      +I)
AG 410 S(I)=INT((N(I)-1)/13)+1:
      N(I)=N(I)-(INT((N(I)-1)/
      13)*13)
EA 420 N$(I)=MID$(NN$,N(I)*2-1,
      2)
QQ 430 NEXT
CS 440 IFN(1)<N(2)THENCR=1:ELSE
       IFN(1)>N(2)THENCR=0:ELS
      EGOTO380
FC 450 RETURN
AM 460 PRINT"{CLR}"
MC 470 FORI=1TO2
GX 480 IFS(I)=1THENS$="{BLK}A":
      C$="{BLK}"
CX 490 IFS(I)=2THENS$="{BLK}X":
      C$="{BLK}"
BA 500 IFS(I)=3THENS$="{RED}S":
      C$="{RED}"
JG 510 IFS(I)=4THENS$="{RED}Z":
      C$="{RED}"
HS 520 IF N$(I)<>"10"THENN$(I)=
      RIGHT$(N$(I),1)
DG 530 N$(I)=C$+N$(I)
XB 540 SX=8:SY=(I-1)*10+4:NU$=N
      $(I):SU$=S$:GOSUB3850:GO
      SUB3910:NEXT
BQ 550 CHAR1,15,1:PRINT"{1}CUT
      {SPACE}FOR DEAL"
SS 560 CHAR1,15,7:PRINT"{3}COMP
      UTER CUT"
PR 570 CHAR1,15,17:PRINT"{7}";B
      B$;"'S CUT"
QB 580 SYS5916:SYS5916:SYS5916
AP 590 RETURN
DC 600 PRINT"{CLR}"
DA 610 FORI=1TO13:N$(I)=MID$(NN
      $,N(I)*2-1,2)
QK 620 IFS(I)=1THENS$(I)="{BLK}
      A":C$="{BLK}"
KR 630 IFS(I)=2THENS$(I)="{BLK}
      X":C$="{BLK}"
PA 640 IFS(I)=3THENS$(I)="{RED}
      S":C$="{RED}"
PE 650 IFS(I)=4THENS$(I)="{RED}
      Z":C$="{RED}"
QH 660 IF N$(I)<>"10"THENN$(I)=
      RIGHT$(N$(I),1)
GP 670 N$(I)=C$+N$(I):NEXT
XR 680 FORI=7TO12
XE 690 NU$=N$(I):SU$=S$(I):NM=I
      -6:SX=(I-7)*5:SY=1:GOSUB
      3850:GOSUB3960:SY=15:GOS
      UB3850:GOSUB3910:GOSUB40
      20
MR 700 NEXT
FG 710 BR$="{YEL}I{DOWN}{LEFT}-
      {DOWN}{LEFT}-{DOWN}
      {LEFT}{Q}{DOWN}{LEFT}-
      {DOWN}{LEFT}-{DOWN}
      {LEFT}K{3 UP}"
```

```
KS 720 IFCRTHENCR$="{3}COMPUTER
       CRIB":ELSECR$="{7}"+BB$
       +"'S CRIB"
BD 730 CHAR1,30,1:PRINTBR$+"{3}
       COMPUTER{DOWN}{6 LEFT}HA
       ND"
HH 740 CHAR1,30,15:PRINTBR$+"
       {7}";BB$;"'S":CHAR1,31+I
       NT(LEN(BB$)/3),19:PRINT"
       HAND"
FX 750 CHAR1,20,8:PRINTBR$+CR$
FH 760 RETURN
JE 770 REM PLAYER'S DISCARDS
PA 780 D1=0:D2=0:HH=54:SX=16:SY
       =23:CHAR1,4,23:PRINT"{7}
       DISCARD # 1":GOSUB1230:D
       1=VAL(A$):CHAR1,4,23:PRI
       NT"{16 SPACES}"
RB 790 SX=(D1-1)*5:SY=15:GOSUB3
       990:GOSUB4050:SY=8:SX=10
       :NU$=N$(D1+6):SU$=S$(D1+
       6):GOSUB3850:GOSUB3910
JP 800 SX=16:SY=23:CHAR1,4,23:P
       RINT"{3}DISCARD # 2":GOS
       UB1230:D2=VAL(A$):CHAR1,
       4,23:PRINT"{16 SPACES}"
GS 810 IF(D1<>D2)THEN830
HE 820 SX=10:SY=8:GOSUB3990:SY=
       15:SX=(D1-1)*5:NU$=N$(D1
       +6):SU$=S$(D1+6):NM=D1:G
       OSUB3850:GOSUB3910:GOSUB
       4020:GOTO780
XG 830 SX=(D2-1)*5:SY=15:GOSUB3
       990:GOSUB4050:SY=8:SX=15
       :NU$=N$(D2+6):SU$=S$(D2+
       6):GOSUB3850:GOSUB3910
DK 840 SYS5916
HK 850 GOSUB1040:PRINT"{CLR}":F
       ORI=1TO4
BC 860 SX=(I-1)*5:SY=1:GOSUB385
       0:GOSUB3960:SY=15:NU$=PN
       $(I):SU$=PS$(I):NM=I:GOS
       UB3850:GOSUB3910:GOSUB40
       20:NEXT
QC 870 CHAR1,0,0:PRINT"{6}{RVS}
       {39 SPACES}":POKE1063,16
       0:POKE55335,13
JA 880 CHAR1,20,1:PRINT"{2}{A}*
       ****************{S}"
MX 890 CHAR1,20,2:PRINT"-{PUR}
       PEGGING POINTS{2 SPACES}
       {2}-"
DP 900 CHAR1,20,3:PRINT"{Q}****
       ****{R}********{W}"
MF 910 CHAR1,25-INT(LEN(BB$)/2)
       ,4:PRINT"{7}";BB$;"{2}"
MD 920 CHAR1,20,4:PRINT"-
       {8 RIGHT}-{3}COMPUTER{2}
       -"
MP 930 CHAR1,20,5:PRINT"{Q}****
       ****+********{W}"
EX 940 CHAR1,20,6:PRINT"-
       {8 SPACES}-{8 SPACES}-"
HP 950 CHAR1,20,7:PRINT"{Z}****
       ****{E}********{X}"
XB 960 CHAR1,21,16:PRINT"{1}{A}
       **********{S}"
MX 970 CHAR1,21,17:PRINT"-
       {10 SPACES}-"
JK 980 CHAR1,21,18:PRINT"{Q}***
       ******?*{W}"
DX 990 CHAR1,21,19:PRINT"-{RED}
       {RVS}{10 SPACES}{OFF}-"
XK 1000 CHAR1,21,20:PRINT"{Z}**
        ********{X}"
FK 1010 SY=15
MC 1020 SX=34:NU$=N$(13):SU$=S$
        (13):GOSUB3850:GOSUB391
        0:CHAR1,SX+1,SY+5:PRINT
        "{1}CUT"
SB 1030 RETURN
HD 1040 J=1:K=1
CJ 1050 FORI=7TO12
QP 1060 IF(I=(D1+6))OR(I=(D2+6)
        )THEN1100
SG 1070 PN(J)=N(I):PS(J)=S(I):P
        N$(J)=N$(I):PS$(J)=S$(I
        )
GC 1080 J=J+1
SF 1090 GOTO1120
XC 1100 NC(K)=N(I):SC(K)=S(I):N
        C$(K)=N$(I):SC$(K)=S$(I
        )
BD 1110 K=K+1
PH 1120 NEXT
AJ 1130 J=1:K=3
CC 1140 FORI=1TO6
AR 1150 IF(I=D3)OR(I=D4)THEN119
        0
RA 1160 CN(J)=N(I):CS(J)=S(I):C
        N$(J)=N$(I):CS$(J)=S$(I
        )
XJ 1170 J=J+1
GP 1180 GOTO1210
CF 1190 NC(K)=N(I):SC(K)=S(I):N
        C$(K)=N$(I):SC$(K)=S$(I
        )
GK 1200 K=K+1
AQ 1210 NEXT
RR 1220 RETURN
FX 1230 BL=0
MK 1240 GETA$:BL=ABS(BL-1):CHAR
        1,SX,SY:PRINT"{6}";:IFB
        LTHENPRINT"{RVS}{+}":EL
        SEPRINT"{+}"
JG 1250 IFA$=""THEN1240
CR 1260 IFLEN(A$)>1THENA$="":GO
        TO1240
FE 1270 IFD2THEN1290
SE 1280 IFA$="H"THENGOSUB2300:G
        OTO1240
PH 1290 IF(ASC(A$)<49)OR(ASC(A$
        )>HH)THEN1240
XS 1300 CHAR1,SX,SY:PRINTA$:RET
        URN
GC 1310 CHAR1,0,0:PRINT"{6}
        {RVS}{39 SPACES}":PTS=0
        :CHAR1,29,17:PRINT"
        {3 SPACES}":CHAR1,22,17
        :PRINT"{5}TALLY =";TAL:
        IFSG=SFTHEN2100
MP 1320 PRINT"{6}":CHAR1,0,0
BP 1330 IFSF-SG<3THEN1350
FB 1340 IF(NP(I)=NP(I-1))AND(NP
        (I)=NP(I-2))AND(NP(I)=N
        P(I-3))THENPTS=12:PRINT
        "{RVS}FOUR OF A KIND FO
        R 12.{OFF}";:GOTO1380
QX 1350 IFSF-SG<2THEN1370
ES 1360 IF(NP(I)=NP(I-1))AND(NP
        (I)=NP(I-2))THENPTS=6:P
        RINT"{RVS}THREE OF A KI
        ND FOR 6.{OFF}";:GOTO13
        80
AE 1370 IFNP(I)=NP(I-1)THENPTS=
        2:PRINT"{RVS}PAIR FOR 2
        .{OFF}";
MS 1380 IFTAL=31THENPTS=PTS+2:P
        RINT"{RVS} 31 FOR 2.
        {OFF}"
GE 1390 IFTAL=15THENPTS=PTS+2:P
        RINT"{RVS} 15 FOR 2.
        {OFF}";
PH 1400 IFSF-SG<2THEN2100
SE 1410 FORAD=1TO(SF-(SG+1)):GO
        SUB1480:CNT=0
GH 1420 IF(QT(SF)-QT(SG+AD))>(S
        F-(SG+AD))THEN1460
PF 1430 FORH=(SG+AD)TOSF:IF(QT(
        H)+1)=QT(H+1)THENCNT=CN
        T+1
SQ 1440 NEXT
HG 1450 IF((SF+1)-(SG+AD))=CNTT
        HENPTS=PTS+CNT+1:PRINT
        {RVS} RUN FOR";CNT+1;"
        {LEFT}.{OFF}";:GOTO2100
ER 1460 NEXT
SM 1470 GOTO2100
EX 1480 FORH=(SG+AD)TOSF+1:QT(H
        )=NP(H):NEXT
CM 1490 FORG=(SG+AD)TOSF+1:FORH
        =(SG+AD)TOSF
EK 1500 IFQT(H+1)<QT(H)THENBIG=
        QT(H):QT(H)=QT(H+1):QT(
        H+1)=BIG
BF 1510 NEXT:NEXT
SS 1520 RETURN
JG 1530 REM PEG SUBROUTINE
AR 1540 PC=0:PP=0:TAL=0:SF=0:SG
        =0:DU=0:I=1:SP=0
GG 1550 TU=CR:IFN(13)<>11THEN15
        60:ELSECHAR1,0,0:PRINT"
        {6}{RVS}TWO FOR HIS HEE
        LS":SYS5916:SYS5916:IFC
        RTHENPC=2:ELSEPP=2
DH 1560 GOSUB1310
SJ 1570 DO UNTIL I=9:PL(I)=0
HD 1580 IFTUTHENGOSUB3740:ELSE1
        600
AP 1590 IFDUTHEN1620:ELSEIFSPTH
        ENI=I-1:SF=SF-1:GOTO168
        0:ELSESP=1
EF 1600 TU=0:GOSUB3670
EQ 1610 IFDUTHENGOSUB1750:GOTO1
        660:ELSEIFSPTHENI=I-1:S
        F=SF-1:GOTO1680:ELSESP=
        1:TU=1:GOTO1580
KX 1620 HH=52:SX=30:SY=19:CHAR1
        ,22,19:PRINT"{GRN} CARD
        #{3 SPACES}{2 LEFT}":G
        OSUB1230:NO=VAL(A$)
EM 1630 PL=FNV(PN(NO)):IF(PN(NO
        )=32)OR(TAL+PL>31)THEN1
        620
KQ 1640 CHAR1,22,19:PRINT"{RED}
        {RVS}{10 SPACES}{OFF}";
EJ 1650 PL(I)=PL:NP$(I)=PN$(NO)
        :SP$(I)=PS$(NO):CP$(I)=
        PC$(NO):NP(I)=PN(NO):PN
        (NO)=32
QP 1660 GOSUB1990:TAL=TAL+PL:GO
        SUB1310
KS 1670 IFTAL=31THEN1700:ELSEIF
        I=8THEN1680:ELSE1710
EH 1680 IFTUTHENPP=PP+1:ELSEPC=
        PC+1
XE 1690 CHAR1,26,0:PRINT"{6}
        {RVS}1 FOR THE GO.{OFF}
        ";:GOSUB2100
SH 1700 TAL=0:SG=SF+1:GOSUB3810
AA 1710 I=I+1:TU=ABS(TU-1):SF=S
        F+1:SP=0:IFOVTHENRETURN
QP 1720 LOOP
XJ 1730 SYS5916
HX 1740 RETURN
DH 1750 NP(I)=0:PR=0
KG 1760 FORA=1TO4:PR(A)=0
AM 1770 IFCN(A)=32THEN1910
EC 1780 PL=FNV(CN(A)):IF(TAL+PL
        )>31THEN1910
GE 1790 IFSF=SGTHENGOSUB3430:GO
        TO1900
DA 1800 IF(NP(I-2)=NP(I-1))AND(
        CN(A)=NP(I-1))THENPR(A)
        =PR(A)+30
CA 1810 IFPR>29THEN1910
QR 1820 IF((SF-SG)>1)AND(PL+TAL
        <32)THENGOSUB2150:ELSEG
        OTO1840
MQ 1830 IFPR>14THEN1900
PX 1840 IF(PL+TAL=31)THENPR(A)=
        PR(A)+11:GOTO1900
GA 1850 IFPL+TAL=15THENPR(A)=PR
        (A)+11:GOTO1900
SD 1860 IFPR>10THEN1910
DA 1870 IF(CN(A)=NP(I-1))AND(PL
        +TAL<31)THENPR(A)=PR(A)
        +7:GOTO1900
QH 1880 IFPR>6THEN1910
FS 1890 GOSUB3340
DR 1900 IFPR(A)>PRTHENPR=PR(A)
KJ 1910 NEXT
CP 1920 PR=-10
PE 1930 FORA=1TO4:IFCN(A)=32THE
        N1960
JX 1940 PL=FNV(CN(A)):IF(TAL+PL
        )>31THEN1960
```

```
SR 1950 IFPR(A)>PRTHENPR=PR(A):
        B=A:GOSUB3330
JQ 1960 NEXT
KS 1970 PL=FNV(CN(B)):CN(B)=32
GX 1980 RETURN
FK 1990 IFTU=0THENSY=1:SX=(B-1)
        *5:ELSESY=15:SX=(NO-1)*
        5:GOSUB4050
GM 2000 GOSUB3990
XP 2010 SY=8:SX=(I-1)*4:NU$=NP$
        (I):SU$=SP$(I):GOSUB385
        0:GOSUB3910
BX 2020 RETURN
SM 2030 REM ENTER NAME
QC 2040 SX=25:SY=22:PRINT"{7}":
        CHAR1,0,22:PRINT"PLEASE
         ENTER YOUR NAME:
        {2 SPACES}{RVS}
        {6 SPACES}":PRINT"(SIX
        {SPACE}LETTERS MAXIMUM)
        "
FJ 2050 GETA$:BL=ABS(BL-1):CHAR
        1,SX,SY:PRINT"{7}";:IFB
        LTHENPRINT"{RVS} ":ELSE
        PRINT" "
HE 2060 IFBB$=""THEN2070:ELSEIF
        ASC(A$)=13THEN2080:ELSE
        IFASC(A$)=20THENCHAR1,S
        X,SY:PRINT"{RVS} ":SX=S
        X-1:BB$=LEFT$(BB$,LEN(B
        B$)-1)
RS 2070 IF(ASC(A$)<65)OR(ASC(A$
        )>90)OR(A$="")OR(LEN(A$
        )>1)THENA$="":GOTO2050:
        ELSEBB$=BB$+A$:CHAR1,SX
        ,SY:SX=SX+1:PRINT"{RVS}
        ";A$:IFSX<>31THEN2050
SS 2080 CHAR1,0,22:PRINT"
        {39 SPACES}":CHAR1,0,23
        :PRINT"{21 SPACES}"
KF 2090 RETURN
EM 2100 IFTU=1THENPP=PP+PTS:ELS
        EPC=PC+PTS
GG 2110 PRINT"{7}":CHAR1,24,6:P
        RINTPP:PRINT"{3}":CHAR1
        ,33,6:PRINTPC
DP 2120 GOSUB3600
HP 2130 PTS=0
SH 2140 RETURN
MR 2150 REM CHECK RUNS
KB 2160 FORAD=1TO(SF-(SG+1)):GO
        SUB2240:CNT=0
RE 2170 IF(RT(SF)-RT(SG+AD))>(S
        F-(SG+AD))THEN2220
DS 2180 FORH=(SG+AD)TOSF
PJ 2190 IF(RT(H)+1)=RT(H+1)THEN
        CNT=CNT+1
JP 2200 NEXT
KX 2210 IF((SF+1)-(SG+AD))=CNTT
        HENPR(A)=PR(A)+(5*CNT):
        GOTO2230
GR 2220 NEXT
HM 2230 RETURN
CH 2240 FORH=(SG+AD)TOSF:RT(H)=
        NP(H):NEXT
PB 2250 RT(SF+1)=CN(A)
DH 2260 FORG=(SG+AD)TOSF:FORH=(
        SG+AD)TOSF
KE 2270 IFRT(H+1)<RT(H)THENBIG=
        RT(H):RT(H)=RT(H+1):RT(
        H+1)=BIG
AM 2280 NEXT:NEXT
EB 2290 RETURN
FP 2300 REM HINT SUBROUTINE
BP 2310 IFCRTHENPOKE6783,0:ELSE
        POKE6783,255
CR 2320 CHAR1,12,0:PRINT"{1}THI
        NKING..."
SG 2330 FORI=0TO5:POKE(I+6736),
        N(I+7):POKE(I+6742),S(I
        +7):NEXT
CS 2340 SYS5789:CHAR1,18,0:PRIN
        T"{5 SPACES}"
QK 2350 CHAR1,12,0:PRINT"{7}HIN
        T: ";PEEK(6778)+1;",";P
        EEK(6779)+1
FF 2360 RETURN
MG 2370 SYS5789
BC 2380 D3=PEEK(6778)+1:D4=PEEK
        (6?779)+1
JX 2390 SY=1:SX=(D3-1)*5:GOSUB3
        990
PA 2400 SY=8:SX=0:GOSUB3850:GOS
        UB3960
PS 2410 SY=1:SX=(D4-1)*5:GOSUB3
        990
SG 2420 SY=8:SX=5:GOSUB3850:GOS
        UB3960
CK 2430 RETURN
XA 2440 REM COMPUTER HAND
QJ 2450 FC=1:POKE6757,9
EJ 2460 FORI=1TO4:POKE(6751+I),
        CN(I):NEXT
DG 2470 SYS5663
PD 2480 CH=PEEK(6766)
CF 2490 FORI=1TO3
CD 2500 IFCS(I)=CS(I+1)THENFC=F
        C+1
DM 2510 IF(CN(I)=11)AND(CS(I)=S
        (13))THENCH=CH+1
FS 2520 NEXT
DG 2530 IF(CN(4)=11)AND(CS(4)=S
        (13))THENCH=CH+1
XE 2540 IF(FC=4)AND(S(13)=CS(1)
        )THENCH=CH+5:GOTO2560
SF 2550 IFFC=4THENCH=CH+4
GE 2560 FORI=1TO4:SX=(I-1)*5:SY
        =1:NU$=CN$(I):SU$=CS$(I
        ):GOSUB3850:GOSUB?3910:N
        EXT
GF 2570 GOSUB1020
JP 2580 CHAR1,2,10:PRINT"
        {33 SPACES}"
RX 2590 CHAR1,5,10:PRINT"{3}COM
        PUTER'S SCORE IS";CH
PH 2600 PRINT:PRINT"{RED}
        {10 SPACES}{RVS}HIT A K
        EY"
ED 2610 GETKEYA$
DP 2620 GOSUB3600
RE 2630 RETURN
SG 2640 REM PERSON'S HAND
XX 2650 FP=1:POKE6757,9:FORI=1T
        O4:POKE(6751+I),PN(I):N
        EXT
BS 2660 SYS5663:PH=PEEK(6766)
DM 2670 FORI=1TO3:IFPS(I)=PS(I+
        1)THENFP=FP+1
AJ 2680 IF(PN(I)=11)AND(PS(I)=S
        (13))THENPH=PH+1
DM 2690 NEXT
GG 2700 IF(PN(4)=11)AND(PS(4)=S
        (13))THENPH=PH+1
MC 2710 IF(FP=4)AND(S(13)=PS(1)
        )THENPH=PH+5:GOTO2730
CK 2720 IFFP=4THENPH=PH+4
RJ 2730 FORI=1TO4:SX=(I-1)*5:SY
        =1:NU$=PN$(I):SU$=PS$(I
        ):GOSUB3850:GOSUB3910:N
        EXT
BX 2740 GOSUB1020
ES 2750 CHAR1,2,10:PRINT"
        {33 SPACES}"
CJ 2760 CHAR1,5,10:PRINT"{7}";B
        B$;"'S SCORE IS";PH
SG 2770 PRINT:PRINT"{BLU}
        {10 SPACES}{RVS}HIT A K
        EY"
FX 2780 GETKEYA$
RE 2790 GOSUB3600
GS 2800 RETURN
CX 2810 REM CRIB HAND
DP 2820 FR=1:POKE6757,9
BC 2830 FORI=1TO4:POKE(6751+I),
        NC(I):NEXT
BX 2840 SYS5663
SX 2850 RH=PEEK(6766)
GQ 2860 FORI=1TO3
SM 2870 IFSC(I)=SC(I+1)THENFR=F
        R+1
SM 2880 IF(NC(I)=11)AND(SC(I)=S
        (13))THENRH=RH+1
GK 2890 NEXT
EP 2900 IF(NC(4)=11)AND(SC(4)=S
        (13))THENRH=RH+1
HQ 2910 IF(FR=4)AND(S(13)=SC(1)
        )THENRH=RH+5
SA 2920 FORI=1TO4:SX=(I-1)*5:SY
        =1:NU$=NC$(I):SU$=SC$(I
        ):GOSUB3850:GOSUB3910:N
        EXT
RJ 2930 GOSUB1020
FC 2940 CHAR1,2,10:PRINT"
        {33 SPACES}"
CJ 2950 CHAR1,2,10
CM 2960 IFCRTHENPRINT"{3}CRIB S
        CORE IS";RH;"FOR THE CO
        MPUTER":ELSEPRINT"{7}CR
        IB SCORE IS";RH;"FOR ";
        BB$
FF 2970 PRINT:PRINT"{10 SPACES}
        {RVS}HIT A KEY"
JM 2980 GETKEYA$
JB 2990 GOSUB3600
SM 3000 RETURN
FP 3010 PRINT"{HOME}{5 DOWN}"
SQ 3020 PRINT"{2 SPACES}{A}****
        **********{R}********
        {R}********{S}"
RP 3030 PRINT"{2 SPACES}-AFTER
        {4 RIGHT}HANDS -COMPUTE
        R-{8 RIGHT}-"
AG 3040 PRINT"{2 SPACES}{Z}****
        **********{E}********
        {E}********{X}"
JC 3050 PRINT"{2 SPACES}{A}****
        **********{R}********
        {R}********{S}"
PQ 3060 PRINT"{2 SPACES}-TOTAL
        {SPACE}MATCH PTS-
        {8 RIGHT}-{8 RIGHT}-"
QP 3070 PRINT"{2 SPACES}{Q}****
        **********+********+**
        ******{W}"
GH 3080 PRINT"{2 SPACES}-GAMES
        {SPACE}WON{6 SPACES}-
        {8 RIGHT}-{8 RIGHT}-"
DM 3090 PRINT"{2 SPACES}{Z}****
        **********{E}********
        {E}********{X}"
DA 3100 PRINT"{2 SPACES}{A}****
        **********{R}********
        {R}********{S}"
AP 3110 PRINT"{2 SPACES}-POINTS
         IN HAND -{8 RIGHT}-
        {8 RIGHT}-"
BK 3120 PRINT"{2 SPACES}{Q}****
        **********+********+**
        ******{W}"
SA 3130 PRINT"{2 SPACES}-POINTS
         IN CRIB -{8 RIGHT}-
        {8 RIGHT}-"
XX 3140 PRINT"{2 SPACES}{Q}****
        **********+********+**
        ******{W}"
BP 3150 PRINT"{2 SPACES}-POINTS
         PEGGED{2 SPACES}-
        {8 RIGHT}-{8 RIGHT}-"
FS 3160 PRINT"{2 SPACES}{Q}****
        **********+********+**
        ******{W}"
SG 3170 PRINT"{2 SPACES}-SCORE
        {10 SPACES}-{8 RIGHT}-
        {8 RIGHT}-"
MR 3180 PRINT"{2 SPACES}{Z}****
        **********{E}********
        {E}********{X}"
QJ 3190 RETURN
FD 3200 REM DISPLAY SCORES
XE 3210 RESTORE:PRINT"{CLR}":SY
        =0:FORI=1TO8:SX=(I-1)*4
        +3:GOSUB4070:NEXT
JA 3220 PRINT"{HOME}{5 DOWN}
        {PUR}":PRINT
CB 3230 PRINTTAB(8);HD;TAB(32-I
        NT(LEN(BB$)/2));BB$
RG 3240 PRINT:PRINT:PRINTTAB(22
        );CZ;TAB(31);PZ
```

```
BA 3250 PRINT:PRINTTAB(22);GC;T
        AB(31);GP
KF 3260 PRINT:PRINT:PRINTTAB(22
        );C1;TAB(31);H1
DA 3270 PRINT:PRINTTAB(22);C2;T
        AB(31);H2
RF 3280 PRINT:PRINTTAB(22);C3;T
        AB(31);H3
EK 3290 PRINT:PRINTTAB(22);C4;T
        AB(31);H4
BD 3300 GOSUB3010
GF 3310 IFHD=1THENCHAR1,16,7:PR
        INT" "
QB 3320 RETURN
JC 3330 PL(I)=PL:NP$(I)=CN$(A):
        SP$(I)=CS$(A):CP$(I)=CC
        $(A):NP(I)=CN(A):RETURN
AE 3340 REM
PE 3350 IF(TAL+PL)<15THENPR(A)=
        PR(A)-3:GOTO3430
AX 3360 IFPL=5THENPR(A)=PR(A)-1
EF 3370 IF((PL+TAL)>27)AND(PL<>
        10)THENPR(A)=PR(A)+2:GO
        TO3460
DQ 3380 IF(PL+TAL)>27THENPR(A)=
        PR(A)+1:GOTO3460
FA 3390 IF(PL+TAL<20)AND(PL>6)T
        HENPR(A)=PR(A)+1:GOTO34
        60
FQ 3400 IF((PL+TAL)=21)THENPR(A
        )=PR(A)-2:GOTO3460
XR 3410 IF((PL+TAL)=26)THENPR(A
        )=PR(A)-1
QM 3420 GOTO3460
XS 3430 IF((TAL+PL)=10)OR(PL=10
        )THENPR(A)=PR(A)-1
PF 3440 IF((TAL+PL)=5)OR(PL=5)T
        HENPR(A)=PR(A)-2
QJ 3450 IF((2*PL(I-1)+PL)=15)TH
        ENPR(A)=PR(A)-2
FR 3460 DFF=ABS(CN(A)-NP(I-1)):
        AVR=(CN(A)+NP(I-1))/2:N
        X=INT(AVR+1?.5*DFF-3)
CQ 3470 IF((CN(A)=NP(I-1)+1)OR(
        CN(A)=NP(I-1)-1))AND((P
        L+TAL+NX)<32)THENPR(A)=
        PR(A)-3
AQ 3480 IF((CN(A)=NP(I-1)+2)OR(
        CN(A)=NP(I-1)-2))AND((P
        L+TAL+NX)<32)THENPR(A)=
        PR(A)-2
JQ 3490 FORW=1TO4:IF(W=A)OR(CN(
        W)=32)THEN3580
MB 3500 CUD=FNV(CN(W)):IF((2*PL
        +CUD)=31)OR((2*PL+CUD)=
        15)ANDPL<>5THENPR(A)=PR
        (A)+2
XS 3510 IF((CUD+10+PL)=31)OR((C
        UD+10+PL)=15)ANDPL<>5TH
        ENPR(A)=PR(A)+3
EJ 3520 IFSG<>SFTHEN3580
CB 3530 IF(CN(A)=CN(W))AND(PL<>
        5)THENPR(A)=PR(A)+4
CX 3540 IF(PL+CUD)=15THENPR(A)=
        PR(A)+2
PX 3550 IF((CN(A)+1=CN(W))OR(CN
        (A)-1=CN(W)))ANDCN(A)<>
        5THENPR(A)=PR(A)+3
DX 3560 IF((CN(A)+2=CN(W))OR(CN
        (A)-2=CN(W)))ANDCN(A)<>
        5THENPR(A)=PR(A)+2
PF 3570 IFPL<5THENPR(A)=PR(A)+1
FD 3580 NEXT
GD 3590 RETURN
RM 3600 TC=C4:TP=H4
HB 3610 TC=TC+PC+CH
FM 3620 IFCRTHENTC=TC+RH
EE 3630 TP=TP+PP+PH
CR 3640 IFCR=0THENTP=TP+RH
DF 3650 IFTC>120ORTP>120THENGOS
        UB4170
KH 3660 RETURN
AP 3670 REM ROUTINE TO SEE IF C
        OMPUTER CAN PLAY
CX 3680 DU=0
DD 3690 FORE=1TO4
DG 3700 IF(CN(E)=32)OR(TAL+FNV(
        CN(E))>31)THEN3720
BS 3710 DU=1
DP 3720 NEXT
JP 3730 RETURN
HQ 3740 REM ROUTINE TO SEE IF P
        ERSON CAN PLAY
ED 3750 DU=0
CH 3760 FORE=1TO4
RX 3770 IF(PN(E)=32)OR(TAL+FNV(
        PN(E))>31)THEN3790
FE 3780 DU=1
XB 3790 NEXT
PX 3800 RETURN
MQ 3810 FORWE=1TOI
XH 3820 SY=8:SX=(WE-1)*4:GOSUB3
        960
HA 3830 NEXT
GA 3840 RETURN
CS 3850 REM DRAW CARD OUTLINE
KB 3860 PRINT"{BLU}"
HE 3870 CHAR1,SX,SY:PRINT"U***I
        "
SE 3880 FORHI=1TO5:CHAR1,SX,SY+
        HI:PRINT"-{3 SPACES}-":
        NEXT
AJ 3890 CHAR1,SX,SY+6:PRINT"J**
        *K"
EF 3900 RETURN
XA 3910 REM DRAW NUMBER & SUIT
MH 3920 CHAR1,SX+1,SY+1:PRINTNU
        $
KP 3930 CHAR1,SX+2,SY+3:PRINTSU
        $
QB 3940 CHAR1,SX+5-LEN(NU$),SY+
        5:PRINTNU$
DK 3950 RETURN
CH 3960 REM DRAW CARD BACKS
BE 3970 PRINT"{RED}":FORHI=1TO5
        :CHAR1,SX+1,SY+HI:PRINT
        "{3 +}":NEXT
QM 3980 RETURN
FE 3990 REM BLANK OUT CARD
CX 4000 FORHI=0TO6:CHAR1,SX,SY+
        HI:PRINT"{5 SPACES}":NE
        XT
EP 4010 RETURN
XQ 4020 REM NUMBER CARDS
DM 4030 PRINT"{1}":CHAR1,SX+1,S
        Y+7:PRINTNM
RQ 4040 RETURN
DQ 4050 CHAR1,SX+2,SY+7:PRINT"
        {SPACE}"
DX 4060 RETURN
RC 4070 REM OPENING DISPLAY
GS 4080 PRINTCHR$(148+I)
BC 4090 FORHI=1TO5:READNU$:CHAR
        1,SX+1,SY+HI:PRINTCHR$(
        18)+NU$:NEXT
EC 4100 RETURN
RP 4110 C1=C1+CH:H1=H1+PH
EK 4120 IFCRTHENC2=C2+RH
SS 4130 IFCR=0THENH2=H2+RH
FD 4140 C3=C3+PC:H3=H3+PP
SM 4150 C4=C3+C2+C1:H4=H3+H2+H1
CH 4160 RETURN
FJ 4170 GOSUB4110
PH 4180 IFH4<61THENCZ=CZ+(3*(12
        1-H4)):GC=GC+3:GOTO4230
GB 4190 IFH4<91THENCZ=CZ+(2*(12
        1-H4)):GC=GC+2:GOTO4230
DC 4200 IFC4<61THENPZ=PZ+(3*(12
        1-C4)):GP=GP+3:GOTO4230
ED 4210 IFC4<91THENPZ=PZ+(2*(12
        1-C4)):GP=GP+2:GOTO4230
CB 4220 IFC4>120THENCZ=CZ+121-H
        4:GC=GC+1:ELSEPZ=PZ+121
        -C4:GP=GP+1
CS 4230 GOSUB3200
CC 4240 CHAR1,0,23:PRINT"{RED}
        {5 SPACES}GAME OVER - "
        ;
SJ 4250 IFC4>120THENPRINT"COMPU
        TER HAS WON.":SLEEP5:GO
        TO4280
CP 4260 PRINTBB$;" HAS WON!!!":
        SLEEP5
JQ 4270 IF(H4<61)OR(C4<61)THENC
        HAR1,0,23:PRINT"
        {5 SPACES}DOUBLE SKUNK
        {SPACE}- TRIPLE POINTS
        {6 SPACES}":SLEEP5:GOTO
        4290
RK 4280 IF(H4<91)OR(C4<91)THENC
        HAR1,0,23:PRINT"
        {8 SPACES}SKUNK - DOUBL
        E POINTS{10 SPACES}":SL
        EEP5
KG 4290 CHAR1,0,23:PRINT"
        {8 SPACES}ANOTHER GAME?
        {2 SPACES}(Y/N)
        {11 SPACES}"
KK 4300 GETKEYA$
KF 4310 IFA$="Y"THENOV=1:RETURN
SC 4320 IFA$="N"THENEND
DC 4330 GOTO4300
HD 4340 IFER=30THENRESUME:ELSEP
        RINTERR$(ER);" ERROR IN
         LINE";EL
PD 4350 DATA"£ {*}"," {RIGHT}
        {SPACE}"," {2 RIGHT}","
         {RIGHT} ","{OFF}{*}
        {RVS} {OFF}£","
        {2 SPACES}{*}","
        {RIGHT}{OFF}£","
        {2 SPACES}{*}","
        {RIGHT} "," {RIGHT} ","
        {3 SPACES}","{RIGHT}
        {RIGHT}","{RIGHT}
        {RIGHT}","{RIGHT}
        {RIGHT}","{3 SPACES}","
        {2 SPACES}{*}","
        {RIGHT}{OFF}£","
        {2 SPACES}{*}","
        {RIGHT} ","{2 SPACES}
        {OFF}£"
ME 4360 DATA"{2 SPACES}{*}","
        {RIGHT}{OFF}£","
        {2 SPACES}{*}","
        {RIGHT} ","{2 SPACES}
        {OFF}£","£ {*}","
        {RIGHT} ","{3 SPACES}",
        " {RIGHT} "," {RIGHT} "
        ,"£ {*}"," {2 RIGHT}",
        " £ "," {RIGHT} ","
        {OFF}{*}{RVS} {OFF}£",
        "{3 SPACES}","
        {2 RIGHT}","{2 SPACES}
        {RIGHT}"," {2 RIGHT}","
        {3 SPACES}"
```

Zoom

See instructions in article on page 68 before typing in.

Program 1: Zoom—64 Version

```
C000:4C B6 C1 00 AD 02 DD 09 C7
C008:03 8D 02 DD AD 00 DD 29 DE
C010:FC 09 03 8D 00 DD A9 15 6B
C018:8D 18 D0 A9 1B 8D 11 D0 1D
C020:A9 00 85 C6 8D 15 D0 60 56
C028:AD 02 DD 09 03 8D 02 DD 7D
C030:AD 00 DD 29 FC 09 03 8D 76
C038:00 DD AD 18 D0 09 08 8D B0
C040:18 D0 AD 11 D0 09 20 8D 41
C048:11 D0 60 A9 01 8D 21 D0 7E
C050:A9 D8 85 FE A9 04 85 FC E2
C058:A0 00 84 FB 84 FD AD 03 F4
C060:C0 91 FB A9 00 91 FD C8 CB
C068:D0 F4 E6 FC E6 FE A5 FC B7
C070:C9 08 90 EA 60 D2 AE A0 E5
C078:CA AE A0 C2 C9 D8 C2 D9 5C
C080:AD 5C 03 8D 5A 03 AD 5B BE
C088:03 18 4E 5A 03 6A 4A 4A A1
C090:8D 5F 03 AD 5D 03 4A 4A C1
C098:4A 8D 60 03 AD 5D 03 29 F0
C0A0:07 8D 5E 03 AE 60 03 A9 AB
C0A8:00 8D 61 03 8D 62 03 E0 C6
C0B0:00 F0 15 AD 61 03 18 69 9C
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C0B8:40 8D 61 03 90 03 EE 62 EA
C0C0:03 EE 62 03 CA 4C AF C0 A3
C0C8:8E 63 03 8E 64 03 AD 5F 9D
C0D0:03 18 0A 0A 0A 90 03 EE 43
C0D8:64 03 18 6D 5E 03 8D 63 A4
C0E0:03 90 03 EE 64 03 AD 61 43
C0E8:03 18 6D 63 03 8D 63 03 ED
C0F0:90 03 EE 64 03 AD 62 03 36
C0F8:18 6D 64 03 8D 64 03 A9 4C
C100:20 18 6D 64 03 8D 64 03 A7
C108:AD 5B 03 29 07 8D 65 03 68
C110:A9 07 38 ED 65 03 8D 65 C7
C118:03 A9 01 A2 00 EC 65 03 53
C120:F0 05 0A E8 4C 1D C1 8D 15
C128:66 03 AD 64 03 85 22 AD BB
C130:63 03 85 21 A0 00 B1 21 72
C138:4D 66 03 91 21 20 50 C2 62
C140:AD 00 DC 29 10 F0 09 A0 BF
C148:00 B1 21 4D 66 03 91 21 B4
C150:60 AD 5D 03 38 E9 01 8D 44
C158:5D 03 B0 05 A9 00 8D 5D 77
C160:03 60 AD 5D 03 18 69 01 55
C168:C9 B8 90 02 A9 B7 8D 5D D5
C170:03 60 AD 5B 03 38 E9 01 C6
C178:8D 5B 03 B0 13 AD 5C 03 10
C180:F0 06 A9 00 8D 5C 03 60 77
C188:A9 00 8D 5B 03 8D 5C 03 52
C190:60 AD 5B 03 18 69 01 8D 41
C198:5B 03 90 08 A9 01 8D 5C E5
C1A0:03 4C B5 C1 AD 5B 03 C9 36
C1A8:20 90 0A AD 5C 03 F0 05 52
C1B0:A9 1F 8D 5B 03 60 20 28 3A
C1B8:C0 A9 01 8D 03 C0 20 4B A6
C1C0:C0 A9 00 8D 5C 03 A9 64 8E
C1C8:8D 5D 03 A9 A0 8D 5B 03 5A
C1D0:AD 00 DC 29 0F C9 0E D0 E5
C1D8:06 20 51 C1 4C 2E C2 C9 18
C1E0:0D D0 06 20 62 C1 4C 2E C2
C1E8:C2 C9 07 D0 06 20 91 C1 C3
C1F0:4C 2E C2 C9 0B D0 06 20 E2
C1F8:72 C1 4C 2E C2 C9 06 D0 AC
C200:09 20 51 C1 20 91 C1 4C 6F
C208:2E C2 C9 05 D0 09 20 62 2C
C210:C1 20 91 C1 4C 2E C2 C9 37
C218:09 D0 09 20 62 C1 20 72 46
C220:C1 4C 2E C2 C9 0A D0 06 A9
C228:20 51 C1 20 72 C1 A5 C5 F7
C230:C9 0C D0 03 4C 5B C2 C9 07
C238:3E D0 01 60 C9 2A D0 03 D2
C240:20 01 C5 C9 0D D0 03 20 3D
C248:8F C4 20 80 C0 4C D0 C1 6D
C250:A2 CD A0 00 C8 D0 FD E8 1D
C258:D0 FA 60 20 70 C3 A9 00 F8
C260:85 FD 8D B9 02 8D BA 02 33
C268:8D A8 02 8D 65 C4 A5 21 A2
C270:29 F8 85 FB A9 04 85 FE A0
C278:A5 22 85 FC A0 00 A2 00 24
C280:A9 80 8D BB 02 A9 20 91 F0
C288:FD 8C B9 02 AC BA 02 B1 8D
C290:FB AC B9 02 2D BB 02 F0 E3
C298:04 A9 A0 91 FD 20 B3 C2 52
C2A0:AD 65 C4 C9 03 D0 DE 20 C4
C2A8:04 C0 20 76 C3 20 0C C3 46
C2B0:4C D0 C1 C8 8C B9 02 C0 65
C2B8:00 D0 02 E6 FE AD BB 02 49
C2C0:18 4A 8D BB 02 B0 01 60 87
C2C8:A9 80 8D BB 02 A5 FB 18 67
C2D0:69 08 85 FB 90 02 E6 FC D4
C2D8:E8 E0 05 F0 01 60 A2 00 89
C2E0:A5 FB 38 E9 27 85 FB B0 D5
C2E8:02 C6 FC EE A8 02 AD A8 01
C2F0:02 C9 08 F0 01 60 A9 00 D6
C2F8:8D A8 02 EE 65 C4 A5 FB 24
C300:18 69 38 85 FB 90 02 E6 5A
C308:FC E6 FC 60 A9 00 85 FD C3
C310:8D B9 02 8D BA 02 8D A8 87
C318:02 8D 65 C4 A5 21 29 F8 F9
C320:85 FB A9 04 85 FE A5 22 74
C328:85 FC A0 00 A2 00 A9 80 AE
C330:8D BB 02 A9 00 AC BA 02 72
C338:91 FB AC B9 02 B1 FD 29 B4
C340:80 F0 0A AC BA 02 B1 FB 8D
C348:0D BB 02 91 FB AC B9 02 A6
C350:A5 FB 8D A9 02 20 B3 C2 B0
C358:AD 65 C4 C9 03 D0 07 20 CE
C360:28 C0 20 4B C0 60 A5 FB B3
C368:CD A9 02 F0 CD 4C 33 C3 5A
C370:A9 00 20 4B C0 60 20 5C A9
C378:C4 A0 00 A5 C5 C9 01 D0 0D
C380:04 20 50 C2 60 AD 00 DC DE
C388:29 0F C9 0F D0 06 20 67 D8
C390:C4 4C 7B C3 C9 0E D0 06 67
C398:20 F0 C3 4C 7B C3 C9 06 2E
C3A0:D0 09 20 F0 C3 20 26 C4 95
C3A8:4C 7B C3 C9 07 D0 06 20 F1
C3B0:26 C4 4C 7B C3 C9 05 D0 DD
C3B8:09 20 08 C4 20 26 C4 4C 89
C3C0:7B C3 C9 0D D0 06 20 08 E7
C3C8:C4 4C 7B C3 C9 09 D0 09 8E
C3D0:20 08 C4 20 44 C4 4C 7B 4E
C3D8:C3 C9 0B D0 06 20 44 C4 21
C3E0:4C 7B C3 C9 0A D0 06 20 42
C3E8:44 C4 20 F0 C3 4C 7B C3 E0
C3F0:A5 FB 38 E9 28 85 FB B0 EF
C3F8:0B C6 FC A5 FC C9 03 D0 97
C400:03 20 5C C4 20 67 C4 60 73
C408:A5 FB 18 69 28 85 FB 90 DC
C410:02 E6 FC A5 FC C9 07 90 FB
C418:09 A5 FB C9 C0 90 03 20 1A
C420:5C C4 20 67 C4 60 A5 FB 72
C428:18 69 01 85 FB 90 02 E6 9D
C430:FC A5 FC C9 07 90 09 A5 10
C438:FB C9 C0 90 03 20 5C C4 69
C440:20 67 C4 60 A5 FB 38 E9 C9
C448:01 85 FB B0 0B C6 FC A5 51
C450:FC C9 03 D0 03 20 5C C4 4E
C458:20 67 C4 60 A9 05 85 FC D3
C460:A9 F5 85 FB 60 00 00 B1 61
C468:FB 8D 66 C4 A9 5B 91 FB 46
C470:20 50 C2 AD 66 C4 91 FB B6
C478:A5 C5 C9 40 F0 10 C9 2C 0B
C480:D0 04 A9 A0 91 FB C9 2F F1
C488:D0 04 A9 20 91 FB 60 20 10
C490:04 C0 4C B1 C4 93 0E 4E CF
C498:41 4D 45 20 4F 46 20 47 DB
C4A0:52 41 50 48 49 43 20 54 1E
C4A8:4F 20 53 41 56 45 3A 20 BC
C4B0:00 A2 00 86 C6 BD 95 C4 68
C4B8:F0 07 20 D2 FF E8 4C B5 9F
C4C0:C4 A0 00 20 CF FF 99 EB 74
C4C8:07 C8 C9 0D D0 F5 8C E8 72
C4D0:07 A9 08 A2 08 A0 FF 20 56
C4D8:BA FF AD E8 07 A2 EB A0 3F
C4E0:07 20 BD FF A9 00 85 22 28
C4E8:A9 20 85 23 A9 22 A2 FF 4D
C4F0:A0 3F 20 D8 FF 20 28 C0 BD
C4F8:A9 01 8D 03 C0 20 4B C0 57
C500:60 20 04 C0 4C 20 C5 93 52
C508:0E 4E 41 4D 45 20 4F 46 BA
C510:20 46 49 4C 45 20 54 4F CD
C518:20 4C 4F 41 44 3A 20 00 10
C520:A2 00 86 C6 BD 07 C5 F0 C0
C528:07 20 D2 FF E8 4C 24 C5 20
C530:A0 00 20 CF FF 99 EB 07 52
C538:C8 C9 0D D0 F5 8C E8 07 04
C540:A9 08 A2 08 A0 FF 20 BA 77
C548:FF AD E8 07 A2 EB A0 07 D9
C550:20 BD FF 20 28 C0 A9 00 F4
C558:A2 FF A0 FF 20 D5 FF A9 4B
C560:01 8D 03 C0 20 4B C0 20 0C
C568:28 C0 60 00 00 00 00 00 44
```

Program 2: Zoom—128 Version

```
1300:4C 7D 14 00 A9 00 85 D8 5F
1308:4C 59 6B A9 01 85 D8 4C CE
1310:59 6B A9 01 8D 21 D0 A9 3F
1318:D8 85 FE A9 04 85 FC A0 57
1320:00 84 FB 84 FD AD 03 13 EE
1328:91 FB A9 00 91 FD C8 D0 32
1330:F4 E6 FC E6 FE A5 FC C9 EA
1338:08 90 EA 60 D2 AE A0 CA 47
1340:AE A0 C2 C9 D8 C2 D9 AD 0E
1348:48 17 8D 49 17 AD 4A 17 B9
1350:18 4E 49 17 6A 4A 4A 8D 4F
1358:4B 17 AD 4C 17 4A 4A 4A 25
1360:8D 4D 17 AD 4C 17 29 07 76
1368:8D 4E 17 AE 4D 17 A9 00 D0
1370:8D 4F 17 8D 50 17 E0 00 8D
1378:F0 15 AD 4F 17 18 69 40 33
1380:8D 4F 17 90 03 EE 50 17 B8
1388:EE 50 17 CA 4C 76 13 8E BA
1390:51 17 8E 52 17 AD 4B 17 39
1398:18 0A 0A 0A 90 03 EE 52 EF
13A0:17 18 6D 4E 17 8D 51 17 93
13A8:90 03 EE 52 17 AD 4F 17 FF
13B0:18 6D 51 17 8D 51 17 90 4A
13B8:03 EE 52 17 AD 50 17 18 CC
13C0:6D 52 17 8D 52 17 A9 20 50
13C8:18 6D 52 17 8D 52 17 AD A3
13D0:4A 17 29 07 8D 53 17 A9 09
13D8:07 38 ED 53 17 8D 53 17 30
13E0:A9 01 A2 00 EC 53 17 F0 44
13E8:05 0A E8 4C E4 13 8D 54 D8
13F0:17 AD 52 17 85 22 AD 51 2B
13F8:17 85 21 A0 00 B1 21 4D 90
1400:54 17 91 21 20 09 15 AD 59
1408:00 DC 29 10 F0 09 A0 00 7A
1410:B1 21 4D 54 17 91 21 60 E9
1418:AD 4C 17 38 E9 01 8D 4C 4B
1420:17 B0 05 A9 00 8D 4C 17 21
1428:60 AD 4C 17 18 69 01 C9 19
1430:B8 90 02 A9 B7 8D 4C 17 57
1438:60 AD 4A 17 38 E9 01 8D AF
1440:4A 17 B0 13 AD 48 17 F0 48
1448:06 A9 00 8D 48 17 60 A9 BF
1450:00 8D 4A 17 8D 48 17 60 B2
1458:AD 4A 17 18 69 01 8D 4A 03
1460:17 90 08 A9 01 8D 48 17 B9
1468:4C 7C 14 AD 4A 17 C9 20 95
1470:90 0A AD 48 17 F0 05 A9 CD
1478:1F 8D 4A 17 60 20 0B 13 FA
1480:A9 01 8D 03 13 20 12 13 EF
1488:A9 00 8D 48 17 A9 64 8D 71
1490:4C 17 A9 A0 8D 4A 17 AD 55
1498:00 DC 29 0F C9 0E D0 06 3C
14A0:20 18 14 4C F5 14 C9 0D C6
14A8:D0 06 20 29 14 4C F5 14 23
14B0:C9 07 D0 06 20 58 14 4C D0
14B8:F5 14 C9 0B D0 06 20 39 E2
14C0:14 4C F5 14 C9 06 D0 09 17
14C8:20 18 14 20 58 14 4C F5 2D
14D0:14 C9 05 D0 09 20 29 14 52
14D8:20 58 14 4C F5 14 C9 09 0B
14E0:D0 09 20 29 14 20 39 14 F1
14E8:4C F5 14 C9 0A D0 06 20 93
14F0:18 14 20 39 14 A5 D4 C9 6C
14F8:0C D0 03 4C 14 15 C9 48 51
1500:D0 01 60 20 47 13 4C 97 97
1508:14 A2 CD A0 00 C8 D0 FD 6B
1510:E8 D0 FA 60 20 29 16 A9 C3
1518:00 85 FD 8D 55 17 8D 56 B4
1520:17 8D 57 17 8D 1E 17 A5 4E
1528:21 29 F8 85 FB A9 04 85 B8
1530:FE A5 22 85 FC A0 00 A2 EC
1538:00 A9 80 8D 58 17 A9 20 48
1540:91 FD 8C 55 17 AC 56 17 C8
1548:B1 FB AC 55 17 2D 58 17 6A
1550:F0 04 A9 A0 91 FD 20 6C 64
1558:15 AD 1E 17 C9 03 D0 DE 88
1560:20 04 13 20 2F 16 20 C5 D7
1568:15 4C 97 14 C8 8C 55 17 9E
1570:C0 00 D0 02 E6 FE AD 58 1C
1578:17 18 4A 8D 58 17 B0 01 D7
1580:60 A9 80 8D 58 17 A5 FB 94
1588:18 69 08 85 FB 90 02 E6 7F
1590:FC E8 E0 05 F0 01 60 A2 CE
1598:00 A5 FB 38 E9 27 85 FB 22
15A0:B0 02 C6 FC EE 57 17 AD FC
15A8:57 17 C9 08 F0 01 60 A9 F3
15B0:00 8D 57 17 EE 1E 17 A5 5E
15B8:FB 18 69 38 85 FB 90 02 D6
15C0:E6 FC E6 FC 60 A9 00 85 79
15C8:FD 8D 55 17 8D 56 17 8D F2
15D0:57 17 8D 1E 17 A5 21 29 BA
15D8:F8 85 FB A9 04 85 FE A5 D4
15E0:22 85 FC A0 00 A2 00 A9 5B
15E8:80 8D 58 17 A9 00 AC 56 30
15F0:17 91 FB AC 55 17 B1 FD BD
15F8:29 80 F0 0A AC 56 17 B1 35
1600:FB 0D 58 17 91 FB AC 55 15
1608:17 A5 FB 8D 59 17 20 6C 55
1610:15 AD 1E 17 C9 03 D0 07 6A
1618:20 0B 13 20 12 13 60 A5 BE
1620:FB CD 59 17 F0 CD 4C EC 9E
1628:15 A9 00 20 12 13 60 20 09
```

```
1630:15 17 A0 00 A5 D4 C9 01 D5
1638:D0 04 20 09 15 60 AD 00 E7
1640:DC 29 0F C9 0F D0 06 20 8B
1648:20 17 4C 34 16 C9 0E D0 DB
1650:06 20 A9 16 4C 34 16 C9 47
1658:06 D0 09 20 A9 16 20 DF A4
1660:16 4C 34 16 C9 07 D0 06 A4
1668:20 DF 16 4C 34 16 C9 05 B6
1670:D0 09 20 C1 16 20 DF 16 6E
1678:4C 34 16 C9 0D D0 06 20 0F
1680:C1 16 4C 34 16 C9 09 D0 9A
1688:09 20 C1 16 20 FD 16 4C 4C
1690:34 16 C9 0B D0 06 20 FD 23
1698:16 4C 34 16 C9 0A D0 06 E8
16A0:20 FD 16 20 A9 16 4C 34 93
16A8:16 A5 FB 38 E9 28 85 FB 43
16B0:B0 0B C6 FC A5 FC C9 03 58
16B8:D0 03 20 15 17 20 20 17 F3
16C0:60 A5 FB 18 69 28 85 FB 7A
16C8:90 02 E6 FC A5 FC C9 07 26
16D0:90 09 A5 FB C9 C0 90 03 71
16D8:20 15 17 20 20 17 60 A5 03
16E0:FB 18 69 01 85 FB 90 02 8D
16E8:E6 FC A5 FC C9 07 90 09 E0
16F0:A5 FB C9 C0 90 03 20 15 1A
16F8:17 20 20 17 60 A5 FB 38 F7
1700:E9 01 85 FB B0 0B C6 FC 10
1708:A5 FC C9 03 D0 03 20 15 99
1710:17 20 20 17 60 A9 05 85 80
1718:FC A9 F5 85 FB 60 00 00 A7
1720:B1 FB 8D 1F 17 A9 5B 91 71
1728:FB 20 09 15 AD 1F 17 91 78
1730:FB A5 D4 C9 40 F0 10 C9 AC
1738:2C D0 04 A9 A0 91 FB C9 D8
1740:2F D0 04 A9 20 91 FB 60 F4
1748:00 00 00 00 00 00 00 00 76
1750:00 00 00 00 00 00 00 00 7E
1758:00 00 00 00 00 00 00 00 86
```

BB Barrage

See instructions in article on page 30 before typing in.

Program 1: BB Barrage

```
C000:4C 0F C0 4C 17 C0 4C E3 80
C008:C7 4C 7F C8 20 7F C8 A9 37
C010:93 20 D2 FF 20 7F C8 20 6E
C018:E3 C7 AD 11 D0 09 20 8D BC
C020:11 D0 AD 18 D0 09 08 8D DD
C028:18 D0 A9 00 8D F5 CA 8D 86
C030:F6 CA 85 A1 20 85 C2 A9 F0
C038:00 8D 46 C0 A9 20 8D 47 22
C040:C0 A9 00 A0 00 99 21 79 B8
C048:C8 D0 FA AE 47 C0 E8 8E 4A
C050:47 C0 E0 40 D0 EF 20 CE 1B
C058:C2 A2 3F A0 00 BD AD C9 F1
C060:99 00 1E 9D 80 1F 9D 40 48
C068:1E 99 40 1F 20 1E C3 99 F3
C070:80 1E 99 C0 1F 9D C0 1E 08
C078:9D 00 1F C8 CA 10 DE A2 30
C080:3F A9 00 9D 40 03 9D 80 AF
C088:03 CA 10 F7 A2 19 BD 20 D4
C090:CA 9D 40 03 CA 10 F7 A9 47
C098:01 8D 15 D0 A9 0D 8D F8 43
C0A0:07 A2 31 BD 3A CA 9D 80 09
C0A8:03 CA 10 F7 A9 0E 8D F9 7A
C0B0:07 AD FD CA 8D 27 D0 A9 E1
C0B8:00 A2 00 9D 7C 79 9D 74 36
C0C0:81 9D 76 7F E8 D0 F4 AE 54
C0C8:F4 CA CA A9 80 9D 74 81 50
C0D0:CA E0 02 D0 F8 BD 50 C9 66
C0D8:9D 7A 7B BD 53 C9 9D 79 89
C0E0:7C BD 5E C9 9D 7C 79 BD 08
C0E8:56 C9 9D 6F 86 8E 18 79 CA
C0F0:BD 61 C9 9D 7B 7A CA 10 28
C0F8:DC A0 00 8C 18 79 20 09 C9
C100:C7 A0 01 8C 18 79 20 09 68
C108:C7 A2 03 8E 1C 79 E8 8E 88
C110:1D 79 A9 19 8D D2 C3 20 A6
C118:24 C3 20 42 C6 20 BB C1 B6
C120:20 E4 FF C9 86 D0 08 AD BE
C128:5D C9 49 01 8D 5D C9 AD 29
C130:5D C9 D0 EC AD 20 79 F0 8F
C138:D9 CD F7 CA F0 21 AE F4 26
C140:CA CA BD 74 81 D0 0D BD 02
C148:76 7F F0 08 20 8F C4 A9 F7
C150:80 9D 74 81 CA E0 02 D0 D0
C158:E9 20 85 C2 4C 12 C1 A9 8D
C160:A0 8D 02 D0 A9 72 8D 03 1A
C168:D0 A9 03 8D 15 D0 A9 07 3E
C170:8D 28 D0 A9 02 8D 17 D0 BE
C178:8D 1D D0 AD 10 D0 29 FD 13
C180:8D 10 D0 20 E4 FF C9 00 A5
C188:D0 F9 20 E4 FF C9 4E F0 F9
C190:0F C9 59 D0 F5 A9 01 8D 2C
C198:15 D0 20 7F C8 4C 17 C0 3D
C1A0:A9 00 8D 15 D0 AD 18 D0 3A
C1A8:29 F7 8D 18 D0 AD 11 D0 22
C1B0:29 DF 8D 11 D0 A9 93 20 F7
C1B8:D2 FF 60 A9 18 8D D2 C3 AC
C1C0:A2 02 20 7E C3 A0 00 BD 60
C1C8:74 81 D0 48 20 B4 C4 BD A0
C1D0:70 85 18 69 0C 0A 8D 00 2B
C1D8:D0 90 0B AD 10 D0 09 01 FB
C1E0:8D 10 D0 4C EE C1 AD 10 F7
C1E8:D0 29 FE 8D 10 D0 BD 71 88
C1F0:84 18 69 33 8D 01 D0 AD DC
C1F8:FF CA F0 17 AD 1B D4 30 72
C200:12 BD 78 7D 20 61 C2 9D 8E
C208:78 7D BD 77 7E 20 61 C2 52
C210:9D 77 7E 60 BD 70 85 10 E2
C218:01 C8 B9 64 C9 8D 19 79 FD
C220:B9 F5 CA 18 69 01 8D 20 65
C228:79 99 F5 CA 29 0F 8D 1A F6
C230:79 29 07 48 20 B4 C2 68 E3
C238:A2 3C 20 01 C9 A2 05 20 35
C240:DE C4 A2 02 BD 5E C9 9D 73
C248:7C 79 BD 50 C9 9D 7A 7B 5C
C250:A9 00 9D 78 7D 9D 77 7E B5
C258:9D 74 81 A9 FF 9D 70 85 71
C260:60 48 08 20 1B C3 C9 02 A8
C268:90 16 4A 4A 4A 4A 8D 21 61
C270:79 28 30 06 68 18 ED 21 C3
C278:79 60 68 38 6D 21 79 60 A6
C280:28 68 A9 00 60 A5 A1 CD 14
C288:F8 CA 90 05 F0 03 20 CE 42
C290:C2 A9 00 8D 20 79 85 A1 4E
C298:8D 7A 7D AD F9 CA 85 A2 B6
C2A0:AD FC CA 8D 20 D0 AD 00 0E
C2A8:CB 8D 1E 79 8D 1F 79 A9 58
C2B0:20 8D 00 C9 A2 18 A9 00 0F
C2B8:9D 00 D4 CA 10 FA A9 0A 1E
C2C0:8D 18 D4 A9 FF 8D 0F D4 71
C2C8:A9 80 8D 12 D4 60 20 7F FD
C2D0:C8 A9 18 8D 1A 79 A9 27 32
C2D8:8D 19 79 AE 1A 79 BD ED A5
C2E0:C9 85 FB 85 FD BD 07 CA 44
C2E8:85 FC 38 E9 D4 85 FE AC 7D
C2F0:19 79 B1 FD 48 AD 1B D4 7B
C2F8:AD FB CA 91 FD 68 A2 04 A1
C300:DD BB CA F0 03 CA 10 F8 2A
C308:8A 91 FB 30 03 20 DE C4 D6
C310:CE 19 79 10 C6 CE 1A 79 94
C318:10 BC 60 30 01 60 49 FF 02
C320:18 69 01 60 AE F4 CA 8E A1
C328:18 79 AE 18 79 CA 8E 18 9D
C330:79 E0 02 F0 1C BD 74 81 3E
C338:D0 F0 20 7E C3 20 B4 C4 1D
C340:20 8F C4 20 3D C5 BD 74 47
C348:81 D0 DF 20 26 C4 4C 2A C9
C350:C3 60 BD 77 7E 20 1E C3 75
C358:9D 77 7E BD 6F 86 49 7F DF
C360:9D 6F 86 4C BB C3 A9 17 7F
C368:9D 7A 7B A9 FF 9D 7A 7B 4E
C370:4C BB C3 A9 00 9D 7A 7B 07
C378:9D 79 7C 4C BB C3 18 BD 5C
C380:78 7D 30 1D 7D 7B 7A 9D E7
C388:7B 7A 90 2F BD 7C 79 69 AD
C390:00 9D 7C 79 C9 27 90 23 D5
C398:8E 1D 79 FE 74 81 4C BB CB
C3A0:C3 7D 7B 7A 9D 7B 7A B0 01
C3A8:12 BD 7C 79 E9 00 9D 7C D6
C3B0:79 C9 01 B0 06 8E 1C 79 AE
C3B8:DE 74 81 18 BD 77 7E 30 77
C3C0:17 7D 79 7C 9D 79 7C 90 86
C3C8:24 BD 7A 7B 69 00 9D 7A D9
C3D0:7B C9 19 90 18 4C 52 C3 0F
C3D8:7D 79 7C 9D 79 7C B0 0D 13
C3E0:BD 7A 7B E9 00 9D 7A 7B DA
C3E8:10 03 4C 52 C3 60 BD 7A 7D
C3F0:7B A8 BD 7C 79 0A 0A 0A F1
C3F8:08 18 79 66 C9 85 FB 9D 1A
C400:75 80 B9 80 C9 69 00 28 BF
C408:69 00 85 FC 9D 76 7F BD 4A
C410:71 84 29 07 9D 72 83 A8 6F
C418:BD 70 85 29 07 AA BD A5 E3
C420:C9 11 FB 91 FB 60 BD 7A C2
C428:7B A8 BD 7C 79 0A 0A 0A 2B
C430:08 18 79 66 C9 85 FB 9D 53
C438:75 80 B9 80 C9 69 00 28 F7
C440:69 00 85 FC 9D 76 7F BD 82
C448:71 84 29 07 9D 72 83 A8 A7
C450:BD 70 85 29 03 AA B1 FB 3A
C458:3D 9D C9 F0 1F 20 57 C7 20
C460:A5 A1 CD F8 CA F0 02 B0 3D
C468:09 AE 18 79 A9 00 9D 76 BB
C470:7F 60 A9 02 8D 20 D0 A9 5F
C478:80 8D 00 C9 BD A1 C9 48 92
C480:31 FB 1D 9D C9 91 FB AE 5A
C488:18 79 68 9D 73 82 60 BD 87
C490:76 7F F0 1F BD 76 7F 85 91
C498:FE BD 75 80 85 FD BD 72 D9
C4A0:83 A8 B1 FD 3D 73 82 91 7A
C4A8:FD BD 74 81 F0 05 A9 00 36
C4B0:9D 76 7F 60 BD 7A 7B 0A 75
C4B8:0A 0A 85 02 BD 79 7C 4A B1
C4C0:4A 4A 4A 4A 05 02 9D 71 CC
C4C8:84 BD 7C 79 0A 0A 85 02 B0
C4D0:BD 7B 7A 0A 2A 2A 29 03 57
C4D8:05 02 9D 70 85 60 8A 0A EC
C4E0:0A 0A AA AD 19 79 0A 0A EE
C4E8:0A 08 8D 21 79 AC 1A 79 69
C4F0:B9 66 C9 18 6D 21 79 85 14
C4F8:FB B9 80 C9 69 00 28 69 A0
C500:00 85 FC A0 00 BD C0 CA D9
C508:91 FB E8 C8 C0 08 D0 F5 C2
C510:60 08 18 6D 22 79 8D 23 DC
C518:79 28 30 10 C9 60 90 19 7B
C520:C9 80 B0 15 A9 60 8D 23 25
C528:79 4C 39 C5 C9 9F B0 09 3E
C530:C9 80 90 05 A9 A0 8D 23 31
C538:79 AD 23 79 60 BD 70 85 48
C540:38 ED 72 85 C9 08 B0 43 1D
C548:8D 21 79 BD 71 84 38 ED E9
C550:73 84 C9 0A B0 35 0A 0A 09
C558:0A 6D 21 79 A8 B9 6B CA CD
C560:F0 29 A8 AD 7A 7D 8D 22 A5
C568:79 B9 00 1E 20 11 C5 8D 5F
C570:7A 7D AD 79 7E 8D 22 79 CD
C578:B9 00 1F 20 11 C5 8D 79 FA
C580:7E A9 80 9D 74 81 A9 00 9C
C588:20 C2 C8 60 AC 18 79 B9 66
C590:1C 79 AA BD 74 81 D9 9B B2
C598:C9 F0 14 AE F4 CA CA E0 FB
C5A0:02 F0 4C BD 74 81 C9 80 8C
C5A8:F0 05 D9 9B C9 D0 EF A9 FD
C5B0:01 20 C2 C8 A9 00 9D 74 A6
C5B8:81 B9 7B 7A 9D 7B 7A B9 14
C5C0:7C 79 9D 7C 79 B9 79 7C 86
C5C8:9D 79 7C B9 7A 7B 9D 7A 24
C5D0:7B A9 00 9D 76 7F B9 6F F2
C5D8:86 9D 6F 86 A8 B9 00 1E AF
C5E0:9D 78 7D B9 00 1F 9D 77 D3
C5E8:7E A9 FF 9D 70 85 60 AD FF
C5F0:01 CB D0 FA AD 1B D4 CD 0B
C5F8:F4 CA B0 F2 AA BD 74 81 AD
C600:F0 EC B9 9B C9 9D 74 81 61
C608:60 A9 00 8D 19 79 8D 1A EC
C610:79 8D 1B 79 B9 00 DC 4A 8A
C618:B0 06 AE 57 C9 8E 1A 79 01
C620:4A B0 06 AE 56 C9 8E 1A BB
C628:79 4A B0 06 AE 57 C9 8E 70
C630:19 79 4A B0 06 AE 56 C9 5E
C638:8E 19 79 4A B0 03 EE 1B B1
C640:79 60 AD 1B D4 29 01 8D E4
C648:18 79 A8 20 57 C6 AD 18 A0
C650:79 49 01 8D 18 79 A8 20 FD
C658:09 C6 AD 1A 79 F0 33 30 99
C660:0D B9 6F 86 18 79 59 C9 5C
C668:99 6F 86 4C 78 C6 B9 6F F5
C670:86 18 79 5B C9 99 6F 86 46
```

```
C678:C0 00 F0 0B A9 80 19 6F 26
C680:86 99 6F 86 4C 8F C6 A9 E5
C688:7F 39 6F 86 99 6F 86 20 32
C690:09 C7 AD 1B 79 F0 11 AE 5C
C698:18 79 DE 1E 79 D0 09 AD 1D
C6A0:00 CB 9D 1E 79 4C 8C C5 92
C6A8:60 A0 0F A9 00 99 88 2C AE
C6B0:99 C8 2D 99 08 2F 99 48 F4
C6B8:30 99 88 31 88 10 EE A0 EB
C6C0:01 AD FA CA 99 91 05 99 FC
C6C8:B9 05 99 E1 05 99 09 06 6C
C6D0:99 31 06 88 10 EE 60 C0 7E
C6D8:00 F0 CE A0 17 A9 00 99 7F
C6E0:A8 2D 99 E8 2E 99 28 30 28
C6E8:99 68 31 99 A8 32 88 10 4C
C6F0:EE A0 01 AD FE CA 99 B5 25
C6F8:05 99 DD 05 99 05 06 99 02
C700:2D 06 99 55 06 88 10 EE 91
C708:60 20 D7 C6 AE 18 79 BD BD
C710:6F 86 A8 B9 00 1E 9D 78 D5
C718:7D B9 00 1F 9D 77 7E BD 4C
C720:5E C9 9D 7C 79 BD 61 C9 1C
C728:9D 7B 7A BD 50 C9 9D 7A EF
C730:7B BD 53 C9 9D 79 7C A9 69
C738:07 8D 21 79 20 B4 C4 BD 85
C740:7B 7A 0A 0A 0A 3E 70 85 BD
C748:20 EE C3 AE 18 79 20 7E 6C
C750:C3 CE 21 79 D0 E6 60 8E A2
C758:26 79 8C 27 79 AE 18 79 8D
C760:BD 7A 7B A8 B9 ED C9 85 06
C768:FD B9 07 CA 85 FE AD 1B 91
C770:D4 29 3F 8D FD C8 A9 00 DB
C778:85 02 BD 7C 79 A8 B1 FD 9A
C780:29 0F C9 0F F0 54 C9 00 FE
C788:D0 09 AD 1B D4 8D FD C8 CB
C790:4C C3 C7 C9 01 D0 08 BD E5
C798:6F 86 49 7F 4C C3 C7 C9 6D
C7A0:02 D0 09 BD 6F 86 20 1E 56
C7A8:C3 4C C3 C7 C9 03 D0 09 27
C7B0:A9 C0 38 FD 6F 86 4C C3 1E
C7B8:C7 C9 04 D0 1D A9 40 38 74
C7C0:FD 6F 86 9D 6F 86 A8 B9 76
C7C8:00 1E 9D 78 7D B9 00 1F 0D
C7D0:9D 77 7E A9 02 85 02 20 C1
C7D8:C2 C8 AE 26 79 AC 27 79 7A
C7E0:A5 02 60 A9 04 85 FC A9 44
C7E8:00 85 FB A9 02 85 FD A9 BF
C7F0:CB 85 FE A2 18 A9 00 A0 D9
C7F8:00 91 FB A0 27 91 FB A5 93
C800:FB 18 69 28 85 FB A5 FC A9
C808:69 00 85 FC CA D0 E6 A9 DF
C810:FF 8D E7 07 A9 04 85 FC D7
C818:A9 00 85 FB A0 00 8C 21 2E
C820:79 20 78 C8 B1 FB C9 FF 23
C828:F0 22 A2 04 DD BB CA F0 B3
C830:1C CA 10 F8 AD 21 79 18 11
C838:69 01 8D 21 79 C9 F9 D0 3A
C840:E0 AD 21 79 91 FD 20 71 9F
C848:C8 4C 1C C8 AA 8E 22 79 AE
C850:AD 21 79 F0 05 91 FD 20 C9
C858:71 C8 AD 22 79 C9 FF F0 90
C860:0B 18 69 FA 91 FD 20 71 90
C868:C8 4C 1C C8 A9 FF 91 FD EF
C870:60 E6 FD D0 02 E6 FE 60 C2
C878:E6 FB D0 02 E6 FC 60 A9 4C
C880:04 85 FC A9 01 85 FB A9 6F
C888:02 85 FD A9 CB 85 FE A0 E9
C890:00 B1 FD C9 FA B0 11 18 BF
C898:65 FB 85 FB A5 FC 69 00 40
C8A0:85 FC 20 71 C8 4C 91 C8 B2
C8A8:C9 FF F0 12 38 E9 FA AA 68
C8B0:BD BB CA 91 FB 20 78 C8 9C
C8B8:20 71 C8 4C 91 C8 8D E7 47
C8C0:07 60 8D 23 79 8E 24 79 99
C8C8:8C 25 79 AE 23 79 BD F5 74
C8D0:C8 A8 BD F8 C8 99 05 D4 C3
C8D8:A9 00 99 06 D4 BD FB C8 31
C8E0:99 01 D4 BD FE C8 99 04 48
C8E8:D4 49 01 99 04 D4 AE 24 E5
C8F0:79 AC 25 79 60 00 0E 07 CC
C8F8:92 60 60 64 E8 00 80 80 07
C900:20 8D 23 79 8E 24 79 8C 87
C908:25 79 AE 23 79 A9 5A 8D 49
C910:05 D4 A9 00 8D 06 D4 BD 7C
C918:40 C9 8D 01 D4 BD 48 C9 F7
C920:8D 00 D4 A9 10 8D 04 D4 43
C928:49 01 8D 04 D4 AD 24 79 B1
C930:65 A2 8D 26 79 A5 A2 CD A8
C938:26 79 D0 F9 AC 25 79 60 44
C940:10 12 15 16 19 1C 1F 21 FC
C948:C3 D1 1F 60 1E 31 A5 87 A4
C950:0C 0C 0B 80 80 FF 40 C0 9B
C958:00 01 FF FF 01 00 01 26 5C
C960:13 00 80 00 27 00 00 40 07
C968:80 C0 00 40 80 C0 00 40 B7
C970:80 C0 00 40 80 C0 00 40 BF
C978:80 C0 00 40 80 C0 00 40 C7
C980:20 21 22 23 25 26 27 28 1B
C988:2A 2B 2C 2D 2F 30 31 32 23
C990:34 35 36 37 39 3A 3B 3C 2B
C998:3E 3F 32 FF 01 C0 30 0C D8
C9A0:03 3F CF F3 FC 80 40 20 49
C9A8:10 08 04 02 01 40 40 40 B0
C9B0:40 40 3F 3F 3F 3E 3E 3E FD
C9B8:3D 3D 3C 3C 3B 3A 3A 39 F5
C9C0:38 38 37 36 35 34 33 32 DB
C9C8:31 30 2F 2E 2D 2C 2B 2A 64
C9D0:29 27 26 25 24 22 21 20 E5
C9D8:1E 1D 1B 1A 18 17 16 14 25
C9E0:13 11 10 0E 0C 0B 09 07 CA
C9E8:05 03 01 00 00 00 28 50 80
C9F0:78 A0 C8 F0 18 40 68 90 34
C9F8:B8 E0 08 30 58 80 A8 D0 0C
CA00:F8 20 48 70 98 C0 E8 D8 9C
CA08:D8 D8 D8 D8 D8 D8 D9 D9 A0
CA10:D9 D9 D9 D9 DA DA DA DA B4
CA18:DA DA DA DB DB DB DB DB CC
CA20:0F C0 00 3F F0 00 7F F8 E0
CA28:00 FF FC 00 FF FC 00 FF 51
CA30:FC 00 7F F8 00 3F F0 00 A2
CA38:0F C0 38 80 00 24 80 00 26
CA40:24 80 00 38 8C 88 20 94 E6
CA48:50 20 9A 20 00 00 40 00 E3
CA50:00 80 00 00 00 60 00 02 89
CA58:90 02 05 90 00 01 F2 32 7C
CA60:A2 95 52 D0 93 6A 92 01 70
CA68:00 00 06 00 00 6F 7F 90 0C
CA70:00 00 00 00 60 6F 7F 90 56
CA78:9F 00 00 00 54 60 7F 9F A0
CA80:AB 00 00 4A 4A 52 7F AD D8
CA88:B5 BF 00 3F 40 40 00 C0 A0
CA90:C0 BF 00 3F 40 40 00 C0 2E
CA98:C0 BF 00 35 35 2D 01 D2 05
CAA0:C9 C9 00 00 2B 20 01 E0 4A
CAA8:D4 00 00 00 20 10 01 EF DB
CAB0:E0 00 00 00 00 10 01 EF E8
CAB8:00 00 00 51 40 5D 4D 4E C3
CAC0:00 3C 7E FF FF FF 7E 3C 6E
CAC8:00 00 00 FF FF 00 00 00 5E
CAD0:18 18 18 18 18 18 18 18 66
CAD8:C0 E0 70 38 1C 0E 07 03 C2
CAE0:03 07 0E 1C 38 70 E0 C0 43
CAE8:00 18 18 FF 18 18 00 00 A8
CAF0:02 34 34 65 67 00 00 05 B1
CAF8:0E F0 10 F0 0B 0E 10 01 94
CB00:05 00 FE 24 FD F9 FC 0A 18
CB08:FB 09 FC BD FA BC FC 0A 2A
CB10:FB 09 FC F9 02 FD 24 FE 76
CB18:39 FF 00 00 00 00 00 00 4C
```

Program 2: BB Barrage Screen Editor

```
HE 10 REM COPYRIGHT 1988 COMPU
      TE! PUBLICATIONS, INC. -
       ALL RIGHTS RESERVED
JX 20 IFA=0THENA=1:LOAD"BB",8,
      1
FG 30 POKE51,0:POKE52,32:POKE5
      5,0:POKE56,32:CLR
BE 40 PRINT"{CLR}{2 SPACES}COP
      YRIGHT 1988 COMPUTE! PUB
      ., INC."
MB 50 PRINTTAB(11)"ALL RIGHTS
      {SPACE}RESERVED":FORI=1T
      01500:NEXT
GJ 60 DIMC%(255),C2(24),X(15),
      Y(15)
QD 70 FORI=4TO16:READC2(I):NEX
      T
DM 80 DATA1,1,1,1,1,1,3,4,5,6,
      7,8,9
FB 90 FORI=0TO63:POKE960+I,0:N
      EXT
PG 100 FORI=0TO23STEP3:READA:P
       OKE960+I,A:NEXT
ED 110 DATA255,129,129,129,129
       ,129,129,255
XS 120 FORI=0TO5:READA:H(I)=A:
       C%(A+128)=1:NEXT:C%(32)
       =1
HR 130 DATA32,81,64,93,77,78
SJ 140 FORI=48TO53:C%(I)=2:NEX
       T
QC 150 X(5)=1:X(6)=1:X(7)=1:X(
       9)=-1:X(10)=-1:X(11)=-1
JK 160 Y(10)=-1:Y(14)=-1:Y(6)=
       -1:Y(9)=1:Y(13)=1:Y(5)=
       1
KD 170 U$=CHR$(145):D$=CHR$(17
       ):R$=CHR$(29):L$=CHR$(1
       57):C$=CHR$(147)+D$+D$
SE 180 C%(145)=-14:C%(17)=-13:
       C%(29)=-7:C%(157)=-11
QJ 190 H$=CHR$(159)+CHR$(19)+D
       $+D$+D$+D$+D$
XR 200 FORI=1TO5:READA:C%(A)=1
       :H$=H$+CHR$(A)+D$+L$:NE
       XT
BA 210 DATA209,192,221,205,206
PP 220 FORI=3TO10:READA$:C%(AS
       C(A$))=I:H$=H$+A$+D$+L$
       :NEXT
XC 230 DATAP,S,L,C,M,O,H,E
HX 240 C%(13)=11
XM 250 X=0:Y=4:CH=H(1):US=5195
       7
KE 260 J=56320:V=53248:POKEV+2
       1,1:POKEV+39,7:POKEV+23
       ,0:POKEV+29,0:POKE2040,
       15
CF 270 GOSUB560
RG 280 POKEV+1,Y*8+50:T=X*8+24
       :IFT>255THENPOKEV+16,1:
       GOTO300
AM 290 POKEV+16,0
PF 300 POKEV,255ANDT
EK 310 A=0:T=PEEK(J):F=16ANDT:
       JY=15ANDT
JG 320 IFF=16THEN380
PC 330 IFXTHEN360
ME 340 A=C2(Y):IFA=1THENA$=CHR
       $(H(Y-4))
AK 350 GOTO430
FQ 360 S=Y*40+X+1024:T=CH:IFPE
       EK(S)=CHTHENT=32
PP 370 POKES,T:IFMFTHENGOSUB58
       0
QA 380 DX=X(JY):DY=Y(JY):IFDXO
       RDYTHEN530
FA 390 GETA$
AQ 400 A=C%(ASC(A$+"@")):IFA=0
       THEN310
QM 410 IFA<0THENDX=X(-A):DY=Y(
       -A):GOTO530
RB 420 IFA>2THENPOKE53269,0
KK 430 ONAGOTO450,500,650,660,
       760,820,840,850,1150,13
       30,1340
DR 440 GOTO310
AP 450 S=X+Y*40+1024:CH=ASC(A$
       )-128:T=CH:IFT<0THENT=T
       +128:CH=T
SC 460 IFX=0THEN310
EH 470 IFPEEK(S)=CHTHENT=32
FC 480 POKES,T:IFMFTHENGOSUB58
       0
GB 490 GOTO310
MC 500 S=X+Y*40+1024:CH=H(VAL(
       A$)):IFX=0THEN310
MB 510 T=CH:POKES,T:IFMFTHENGO
       SUB580
```

```
FC 520 GOTO310
SG 530 Y=Y+DY:X=X+DX:IFY<0ORY>
       24THENY=Y-DY
FK 540 IFX>38ORX<0THENX=X-DX
MJ 550 GOTO280
CK 560 POKE53281,15:PRINTC$:PO
       KE53281,0:PRINTH$:SYS49
       161
CC 570 POKE1584,13+MF*128:POKE
       53269,1:RETURN
DH 580 X1=39-X:Y1=24-Y
SX 590 S1=X1+Y1*40+1024:POKES1
       ,T
KQ 600 IFT=77THENT=78:GOTO620
KB 610 IFT=78THENT=77
PX 620 S1=X1+Y*40+1024:POKES1,
       T
RQ 630 S1=X+Y1*40+1024:POKES1,
       T
HS 640 RETURN
JM 650 SYS49155:CLR:GOTO60
CE 660 SYS49158:PRINTC$"SAVE S
       CREEN TO DISK"
DR 670 EA=PEEK(253)+PEEK(254)*
       256+1:SA=US+13
PB 680 HE=INT(EA/256):LE=EA-HE
       *256:HS=INT(SA/256):LS=
       SA-HS*256
QX 690 INPUT"ENTER FILENAME ";
       F$:IFF$=""THENPRINT"ABO
       RTED":GOTO740
GQ 700 OPEN1,8,1,F$:POKE193,LS
       :POKE194,HS
JD 710 POKE174,LE:POKE175,HE
BM 720 SYS62957:CLOSE1
DB 730 PRINT"SAVE COMPLETE"
DR 740 FORI=1TO999:NEXT
JD 750 GOSUB560:GOTO310
JK 760 PRINTC$"LOAD SCREEN FRO
       M DISK"
KC 770 INPUT"ENTER FILENAME ";
       F$:IFF$=""THENPRINT"ABO
       RTED":GOTO810
BP 780 OPEN1,8,0,F$:POKE185,1:
       POKE780,0
ES 790 SYS65493:CLOSE1
AM 800 PRINT"LOAD COMPLETE"
RA 810 GOSUB560:GOTO310
XF 820 POKE53281,15:PRINTC$H$:
       POKE53281,0:X=0:Y=4:CH=
       H(1)
DJ 830 POKE1584,13+MF*128:GOTO
       280
DH 840 MF=1-MF:POKE1584,13+MF*
       128:GOTO310
QS 850 SYS49158:PRINTC$"{HOME}
       {RVS} OPTIONS AND COLOR
       S {OFF}"
BH 860 M$="{DOWN}BACKGROUND":T
       =0:MN=0:MX=15
SH 870 GOSUB1110:BA=T
AE 880 M$="BORDER":T=11:GOSUB1
       110:POKEUS+7,T
AB 890 M$="PUCK COLOR":T=14:GO
       SUB1110:POKEUS+8,T
KD 900 M$="BB COLOR":T=15:GOSU
       B1110:POKEUS+6,T*16+BA
QA 910 M$="RIGHT GUN COLOR":T=
       1:GOSUB1110:POKEUS+9,T*
       16+BA
HX 920 M$="LEFT GUN COLOR":T=1
       :GOSUB1110:POKEUS+5,T*1
       6+BA
CB 930 M$="GOALS NEEDED TO WIN
       ":T=7:MN=1:GOSUB1110:PO
       KEUS+2,T
SQ 940 PRINT"HOW MANY SECONDS
       {SPACE}UNTIL DESTRUCT M
       ODE?"
SP 950 M$="(-1 FOR NO DESTRUCT
       )":T=60:MN=-1:MX=900:GO
       SUB1110
XM 960 IFT<0THENPOKEUS+3,255:G
       OTO980
PF 970 SE=T*60:T1=INT(SE/256):
       POKEUS+3,T1:T2=256-SE+T
       1*256:POKEUS+4,T2
HC 980 M$="FRICTION: 1=ON, 0=O
       FF":T=1:MN=0:MX=1:GOSUB
       1110:POKEUS+10,T
FG 990 PRINT"CHOOSE 0 FOR SHAR
       ED BB'S"
EF 1000 M$="{7 SPACES}1 FOR PO
       SSESSIVE":T=0:GOSUB111
       0:POKEUS+12,T
KB 1010 PRINT"MAXIMUM NUMBER O
       F BB'S IN PLAY"
HM 1020 M$="{3 SPACES}":T=100:
       MN=10:MX=250:GOSUB1110
       :POKEUS-1,T+3
CP 1030 M$="RAPID FIRE DELAY":
       MN=1:MX=100:T=7:GOSUB1
       110:POKEUS+11,T
BD 1040 PRINT:PRINT"{DOWN}SAVE
        NEW VERSION TO DISK (
       Y/N)?"
AX 1050 GETA$:IFA$="N"THEN1100
SG 1060 IFA$<>"Y"THEN1050
BP 1070 FORI=US+13TO53248
PE 1080 IFPEEK(I)=255THENSA=49
       152:EA=I+1:I=53248
KS 1090 NEXT:GOTO680
EA 1100 GOSUB560:GOTO310
DH 1110 PRINTM$"{3 SPACES}"T;
AS 1120 FORI=0TOLEN(STR$(T))+1
       :PRINTL$;:NEXT:INPUTU
SF 1130 IFU<MNORU>MXTHENPRINTU
       $;:PRINTM$"("MN"-"MX")
       {3 SPACES}"T;:GOTO1120
BB 1140 T=U:RETURN
HP 1150 SYS49158:POKEV+21,0:PR
       INTC$TAB(11)"{RVS} COM
       MAND SUMMARY"
CE 1160 PRINT:PRINT" THE FIRST
        FIVE MENU ITEMS CHANG
       E THE"
MD 1170 PRINT" DEFLECTOR TYPE.
       "
PQ 1180 PRINT:PRINT" THE LETTE
       R COMMANDS ARE:{DOWN}"
GJ 1190 PRINT"{2 SPACES}P - PL
       AY WITH CURRENT SETTIN
       GS"
PP 1200 PRINT"{2 SPACES}S - SA
       VE A SCREEN TO DISK"
JE 1210 PRINT"{2 SPACES}L - LO
       AD A SCREEN FROM DISK"
GR 1220 PRINT"{2 SPACES}C - CL
       EAR SCREEN OF ANY BARR
       IERS"
BX 1230 PRINT"{2 SPACES}M - TO
       GGLE SYMMETRY MODE"
EP 1240 PRINT"{2 SPACES}O - CH
       OOSE OPTIONS"
FQ 1250 PRINT"{2 SPACES}H - SH
       OW HELP SCREEN"
FS 1260 PRINT"{2 SPACES}E - EX
       IT THE PROGRAM"
SJ 1270 PRINT: PRINT" COMMANDS
        CAN BE INVOKED BY PRE
       SSING"
RD 1280 PRINT" THAT KEY, OR BY
        MOVING THE CURSOR OVE
       R"
BM 1290 PRINT" AND PRESSING TH
       E FIRE BUTTON."
QE 1300 PRINT:PRINT TAB(8)"
       {RVS} SPACE BAR TO CON
       TINUE "
XF 1310 GETA$:IFA$<>" "THEN131
       0
BB 1320 GOTO260
ED 1330 POKE53269,0:PRINTCHR$(
       147):END
GR 1340 IFX=0THENF=0:GOTO340
HB 1350 GOTO310
```

Program 3: Sample Screen

See instructions in article on page 30 before typing in.

```
CB02:FE 01 FD 20 FE 01 FD 12 25
CB0A:FB FB FB FB FB FB 17 FA D6
CB12:FA FA FA FA FA 04 FB 06 DA
CB1A:FB 04 FA FA FA FA FA FA 74
CB22:0C FA FA FA FA FA FA 03 4A
CB2A:FB 02 FB 02 FB 02 FB 03 C2
CB32:FA FA FA FA FA FA 14 FB FC
CB3A:02 FB 04 FB 02 FB 1B FB 44
CB42:02 FB 06 FB 02 FB 13 FB 7C
CB4A:FB FB FB FB FB FB 02 FB ED
CB52:08 FB 02 FB FB FB FB FB B0
CB5A:FB FB 14 FB 0A FB 16 FC 9A
CB62:16 FC 12 FC 12 FC 16 FC 04
CB6A:0E FC 1A FC 0A FC 44 FC 25
CB72:0A FC 1A FC 0E FC 16 FC EE
CB7A:12 FC 12 FC 16 FC 16 FB 39
CB82:0A FB 14 FB FB FB FB FB 24
CB8A:FB FB 02 FB 08 FB 02 FB 4F
CB92:FB FB FB FB FB FB 13 FB 58
CB9A:02 FB 06 FB 02 FB 1B FB E4
CBA2:02 FB 04 FB 02 FB 14 FA 9D
CBAA:FA FA FA FA FA 03 FB 02 6B
CBB2:FB 02 FB 02 FB 03 FA FA 45
CBBA:FA FA FA FA 0C FA FA FA DA
CBC2:FA FA FA 04 FB 06 FB 04 2A
CBCA:FA FA FA FA FA FA 17 FB 9B
CBD2:FB FB FB FB FB 12 FD 01 CB
CBDA:FE 20 FD 01 FE FF 00 00 C1
```

Shell Booter

Article on page 61.

```
HE 10 REM COPYRIGHT 1988 COMPU
      TE! PUBLICATIONS, INC. -
       ALL RIGHTS RESERVED
EM 20 PRINT"{CLR}{3 SPACES}COP
      YRIGHT 1988 COMPUTE! PUB
      ., INC.":PRINTTAB(11)"AL
      L RIGHTS RESERVED"
MG 30 FORI=3072TO3252:READA:PO
      KEI,A:X=X+A:NEXT
DR 40 IFX<>16815THENPRINT"ERRO
      R IN DATA STATEMENTS.":S
      TOP
EX 50 BSAVE"SHELL.BOOTER",D0,U
      8,B0,P3072 TO P3252
DE 60 DATA 169,8,170,160,1,32,
      186,255
GM 70 DATA 169,9,162,154,160,1
      2,32,189
XB 80 DATA 255,169,0,170,32,10
      4,255,169
EP 90 DATA 0,32,213,255,176,94
      ,169,163
XK 100 DATA 133,45,169,12,133,
      46,169,15
GS 110 DATA 133,47,169,45,162,
      1,160,17
PX 120 DATA 32,101,255,160,3,1
      69,0,141
DK 130 DATA 0,91,136,16,250,16
      9,1,133
XR 140 DATA 45,169,91,133,46,1
      62,3,142
DS 150 DATA 16,18,141,17,18,16
      9,147,32
GS 160 DATA 210,255,24,162,1,1
      60,29,36
JD 170 DATA 215,48,2,160,9,32,
      240,255
HM 180 DATA 32,125,255,68,46,7
      9,46,83
```

```
EM 190 DATA 46,32,83,72,69,76,
      76,32
QX 200 DATA 79,78,32,70,45,49,
      32,75
SA 210 DATA 69,89,0,96,169,11,
      133,208
JK 220 DATA 160,0,185,142,12,1
      53,74,3
MX 230 DATA 200,192,11,208,245
      ,96,80,82
KQ 240 DATA 73,78,84,32,68,83,
      36,13
FE 250 DATA 0,0,68,79,83,32,83
      ,72
GJ 260 DATA 69,76,76,66,65,78,
      75,32
CG 270 DATA 49,50,58,83,89,83,
      32,54
GC 280 DATA 54,53,54,13,0,0,0,
      0
```

3-D Sprites

See instructions in article on page 64 before typing in.

Program 1: 3-D Sprites—Machine Language

```
4000:A2 00 A0 40 98 E4 33 E5 8E
4008:34 B0 04 86 33 84 34 98 64
4010:E4 37 E5 38 B0 04 86 37 EA
4018:84 38 A9 99 8D FE FF A9 C9
4020:49 8D FF FF A9 45 CD 03 A9
4028:5B F0 09 8D 03 5B 20 23 75
4030:45 20 A1 4F 20 F1 40 A9 77
4038:09 8D 00 03 A9 41 8D 01 3F
4040:03 A9 D8 8D FC C7 A9 00 FA
4048:8D FE C7 A9 01 8D FF C7 E8
4050:A9 45 8D 04 03 A9 41 8D B7
4058:05 03 A9 05 8D 06 03 A9 D5
4060:42 8D 07 03 A9 86 8D 08 01
4068:03 A9 42 8D 09 03 A9 75 13
4070:A0 40 4C 1E AB 98 93 12 B5
4078:20 2A 2A 2A 2A 20 20 20 AD
4080:20 20 20 20 20 20 20 33 14
4088:44 20 53 50 52 49 54 45 48
4090:53 20 20 20 20 20 20 20 AA
4098:20 20 20 2A 2A 2A 2A 20 46
40A0:20 20 20 20 20 20 20 20 21
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4E88:C0 85 26 A9 1C 6D FA C7 9A
4E90:85 27 28 90 02 E6 27 60 22
4E98:02 08 0E 15 1C 23 A6 4E 54
4EA0:CA 4E D9 4E F9 4E 01 58 B9
4EA8:20 20 20 20 20 59 20 20 2A
4EB0:20 20 20 5A 20 20 20 20 F0
4EB8:20 52 58 20 20 20 20 20 E8
4EC0:52 59 20 20 20 20 20 52 F6
4EC8:5A 00 0D 4F 55 54 20 4F B4
4ED0:46 20 4D 45 4D 4F 52 59 3C
4ED8:00 05 45 52 41 53 45 20 86
4EE0:41 4C 4C 20 20 41 52 45 AC
4EE8:20 59 4F 55 20 53 55 52 76
```

```
4EF0:45 3F 20 28 59 2F 4E 29 D3
4EF8:00 09 4F 4E 4C 59 20 32 E0
4F00:35 35 20 4C 49 4E 45 53 B0
4F08:20 41 4C 4C 4F 57 45 44 FB
4F10:00 AD 00 DD C9 95 F0 0F 8D
4F18:C9 94 F0 23 A9 A0 8D FA F6
4F20:C7 20 02 57 4C 88 4F A9 2D
4F28:E0 CD FA C7 F0 06 8D FA 3C
4F30:C7 4C F2 57 A9 A0 8D FA 7F
4F38:C7 20 8B 4F 4C 02 57 A9 EB
4F40:E0 8D FA C7 20 88 4F 4C 9C
4F48:F2 57 AD 00 DD C9 95 F0 1E
4F50:05 C9 94 F0 07 60 20 E2 62
4F58:58 4C F2 57 20 D2 59 4C 55
4F60:02 57 20 68 4F 4C 31 EA 59
4F68:A5 C5 C9 07 B0 0C C9 06 44
4F70:F0 19 C9 05 F0 12 C9 04 BE
4F78:F0 01 60 A9 97 8D 00 DD 47
4F80:A9 C8 A2 1B A0 15 D0 0F 36
4F88:A9 95 2C A9 94 8D 00 DD 3A
4F90:AD FC C7 A2 3B A0 29 8D A4
4F98:16 D0 8E 11 D0 8C 18 D0 13
4FA0:60 A9 07 A2 00 9D 00 8C E7
4FA8:9D 00 8D 9D 00 8E 9D 00 17
4FB0:8F E8 D0 F1 A9 90 8D C8 FD
4FB8:4F A9 D0 8D CB 4F A5 01 44
4FC0:48 A9 00 85 01 A8 99 00 24
4FC8:90 99 00 D0 C8 D0 F7 EE 8B
4FD0:C8 4F EE CB 4F AE CB 4F 5E
4FD8:E0 E0 D0 EA A2 3E 9D 80 B2
4FE0:DF CA 10 FA A9 0C 8D 9F 0C
4FE8:DF A9 FE 8D F8 8F A9 99 8D
4FF0:8D FE DF A9 49 8D FF DF 0D
4FF8:A9 15 8D FA DF A9 41 8D C8
5000:FB DF 68 85 01 20 02 57 DF
5008:4C F2 57 A0 03 98 29 FE 4C
5010:0A AA 8E 76 50 B5 F7 D9 BC
5018:B7 50 B5 F8 E9 00 8D 2E 87
5020:50 B5 F9 D9 B7 50 B5 FA 98
5028:E9 00 8D 7D 50 49 00 10 FE
5030:69 8E 3E 50 A2 07 B5 F7 8A
5038:95 57 CA 10 F9 A2 00 98 C6
5040:4A 90 2C 0A 0A 69 57 85 7A
5048:6D A9 00 85 6E B9 BB 50 84
5050:8D 5C 50 8C 6E 50 A0 02 99
5058:B1 6D 38 E9 00 91 6D B0 A4
5060:08 C8 B1 6D E9 00 91 6D 24
5068:88 88 88 F0 EB A0 00 20 91
5070:A0 50 20 19 52 A2 00 98 C0
5078:29 01 6A 6A 49 00 0A 8A CA
5080:90 03 09 02 AA B9 BB 50 6F
5088:95 F7 A9 00 95 F8 8A 49 16
5090:04 AA A5 6D 95 F7 A5 6E AF
5098:95 F8 88 30 23 4C 0D 50 0B
50A0:C0 02 90 12 8C B5 50 A2 D3
50A8:03 B5 57 B4 5B 94 57 95 DF
50B0:5B CA 10 F5 A0 00 60 00 D8
50B8:A0 00 C8 00 9F 00 C7 60 AF
50C0:A2 06 A0 03 B5 F7 D9 B7 71
50C8:50 B0 F4 B5 F8 D0 F0 CA 6F
50D0:CA 30 08 E0 02 D0 ED A0 C1
50D8:01 D0 E9 A5 FB A6 F9 A4 D8
50E0:FD 85 F8 86 F9 84 FA AD EE
50E8:00 DD 29 FE C9 94 F0 03 9B
50F0:20 1C 4F A2 01 86 63 86 2C
50F8:64 A0 FF B5 F9 38 F5 F7 E3
5100:B0 06 94 63 49 FF 69 01 63
5108:95 61 CA 10 EE A5 62 C5 C0
5110:61 90 36 85 65 E6 65 4A 82
5118:85 66 24 64 10 03 20 81 30
5120:51 20 94 51 C6 65 D0 01 89
5128:60 E6 F8 A5 66 18 65 61 ED
5130:85 66 08 38 E5 62 B0 04 D1
5138:28 90 E6 24 28 85 66 A5 FB
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5160:60 E6 F7 A5 66 18 65 62 07
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5170:28 90 E6 24 28 85 66 A5 34
5178:F8 18 65 64 85 F8 4C 59 92
5180:51 A2 01 B5 F9 95 F7 B5 BB
5188:63 49 FF 18 69 01 95 63 8E
5190:CA 10 F0 60 A5 F7 A8 29 48
5198:03 AA BD 11 52 8D CC 51 E3
51A0:49 FF A6 FF 3D 15 52 8D 2D
51A8:CE 51 A5 01 48 A9 00 85 3A
51B0:01 A6 F8 BD 40 55 18 79 79
51B8:00 54 85 6D BD 08 56 79 2C
51C0:A0 54 6D FA C7 85 6E A0 F7
51C8:00 B1 6D 29 00 09 00 91 CD
51D0:6D A5 B1 A2 F0 A4 FF 88 96
51D8:F0 05 88 F0 08 D0 2E A2 D7
51E0:0F 0A 0A 0A 0A 8E 08 52 5C
51E8:8D 0A 52 A5 F8 4A 4A 4A 49
51F0:AA A5 F7 4A 4A 18 7D D0 74
51F8:56 85 6D AD FA C7 7D E9 8C
5200:56 85 6E A0 00 B1 6D 29 D3
5208:00 09 00 91 6D 68 85 01 21
5210:60 3F CF F3 FC 00 55 AA 2B
5218:FF A5 57 85 61 A5 58 85 41
5220:62 A5 5D 38 E5 5B 85 63 99
5228:A5 5E E5 5C 85 64 A5 59 1C
5230:38 E5 57 85 65 A5 5A E5 0A
5238:58 85 66 20 05 53 A5 5B 55
5240:38 E5 6D 85 6D A5 5C E5 21
5248:6E 85 6E 60 AD FE C7 85 D7
5250:63 AD FF C7 85 64 A4 05 9A
5258:88 B9 00 82 A6 CA 20 FA 73
5260:52 18 65 A8 85 61 8A 65 97
5268:A9 85 62 70 28 B9 00 86 45
5270:A6 CA 20 FA 52 18 65 A5 32
5278:08 6D FE C7 85 65 8D C1 77
5280:52 8A 65 B0 28 6D FF C7 67
5288:85 66 8D C5 52 70 06 30 28
5290:04 05 65 D0 03 4C E6 53 9C
5298:20 05 53 A5 6D 18 69 50 42
52A0:99 00 82 A5 6E 69 00 99 6F
52A8:00 83 70 E9 B9 00 84 A6 58
52B0:CA 20 FA 52 18 65 AA 85 78
52B8:61 8A 65 AB 85 62 70 D5 84
52C0:A9 00 85 65 A9 00 85 66 FF
52C8:20 05 53 A5 6E 2A A5 6E 59
52D0:6A 8D DD 52 A5 6D 6A 18 BE
52D8:65 6D 85 6D A9 00 65 6E 99
52E0:70 B3 85 6E A9 64 38 E5 77
52E8:6D 99 00 84 A9 00 E5 6E 7A
52F0:99 00 85 98 F0 03 4C 58 21
52F8:52 60 85 6F 86 6C A9 00 BF
5300:85 6B 4C 67 4D 8C E4 53 FD
5308:A0 10 A9 00 85 67 85 68 75
5310:85 69 85 6A A9 55 85 6B 44
5318:A2 04 B5 62 10 12 49 FF 49
5320:95 62 B5 61 49 FF 95 61 CD
5328:F6 61 D0 02 F6 62 06 6B 95
5330:CA CA 10 E6 A2 0F 06 67 24
5338:26 68 26 69 26 6A 06 61 AF
5340:26 62 90 15 A5 67 18 65 56
5348:63 85 67 A5 68 65 64 85 70
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5358:6A CA 10 DA A9 00 85 6D 5C
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5368:05 6A D0 03 4C E3 53 A5 B4
5370:6A D0 15 A2 02 B5 67 95 98
5378:68 CA 10 F9 A9 00 85 67 67
5380:98 38 E9 08 A8 4C 6F 53 E7
5388:24 6A 30 0B 88 06 67 26 E3
5390:68 26 69 26 6A 10 F5 C8 CC
5398:06 65 26 66 10 F9 46 6A 26
53A0:66 69 66 68 66 67 46 66 EB
53A8:66 65 98 30 36 A5 69 38 45
53B0:E5 65 AA A5 6A E5 66 90 9B
53B8:04 85 6A 86 69 26 6D 26 5D
53C0:6E B0 23 06 67 26 68 26 5A
53C8:69 26 6A 88 10 DF 24 6B 37
53D0:10 11 A5 6D 49 FF 18 69 33
53D8:01 85 6D A5 6E 49 FF 69 6B
53E0:00 85 6E A0 00 60 4C 7E 59
53E8:B9 00 00 00 00 00 00 00 6C
```

Program 2: 3-D Sprites—BASIC

```
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      TE! PUBLICATIONS, INC. -
      ALL RIGHTS RESERVED
RH 20 PRINT"{CLR}{3 SPACES}COP
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CA 30 PRINTTAB(11)"ALL RIGHTS
      {SPACE}RESERVED"
HA 40 PRINT"{2 DOWN}PLEASE WAI
      T ABOUT 40 SECONDS.":AD=
      21504
RH 50 FORI=1TO161:READA:Z=Z+A:
      NEXT:IFZ<>17628THENPRINT
      "{DOWN}DATA STATEMENT ER
      ROR":STOP
BC 60 RESTORE:DEFFNLO(X)=X-256
      *INT(X/256):DEFFNHI(X)=I
      NT(X/256)
JM 70 DEFFNXT(X)=2*(XAND252):D
      EFFNYT(Y)=(YAND7)+40*(YA
      ND248)
FX 80 FORX=0TO159:POKEAD,FNLO(
      FNXT(X)):AD=AD+1:NEXT
KQ 90 FORX=0TO159:POKEAD,FNHI(
      FNXT(X)):AD=AD+1:NEXT
EJ 100 FORY=0TO199:POKEAD,FNLO
      (FNYT(Y)):AD=AD+1:NEXT
XS 110 FORY=0TO199:POKEAD,FNHI
      (FNYT(Y)):AD=AD+1:NEXT
QR 120 FORX=0TO24:POKEAD,FNLO(
      59392+40*X):AD=AD+1:NEX
      T
RK 130 FORX=0TO24:POKEAD,FNHI(
      59392+40*X):AD=AD+1:NEX
      T:READP(0),P(1),P(3),P(
      4)
MJ 140 READC:IFC=99THEN190
DF 150 GOSUB210:READP(2),P(5),
      E
KR 160 FORX=0TO5:POKEAD+X,P(X)
      :NEXT
JP 170 AD=AD+6:P(2)=P(2)+1:P(5
      )=P(5)+1:IFP(2)<=ETHEN1
      60
QA 180 READC:GOSUB210:GOTO140
QQ 190 FORX=0TO64:Q=INT(SIN(X*
      ↑/128)*256+.5)-1:IFQ=-1
      THENQ=0
PS 200 POKEAD,Q:AD=AD+1:NEXT:E
      ND
AJ 210 IFC=0THENRETURN
RD 220 FORX=1TOC:READV:POKEAD+
      X-1,V:NEXT:AD=AD+C:RETU
      RN
SP 230 DATA 189,0,157,0,8,165,
      1,41,248,133
PD 240 DATA 1,162,0,144,160,15
      9,0,0,208
HB 250 DATA 176,223,6,232,240,
      3,76,10,87,0
SF 260 DATA 140,136,143,10,232
      ,208,229,165
XD 270 DATA 1,9,7,133,1,96,8,1
      65,1,41,248
EG 280 DATA 133,1,162,0,144,22
      4,159,0,0
EG 290 DATA 208,240,223,6,232,
      240,3,76,250
PD 300 DATA 87,0,140,200,143,1
      0,232,208
XF 310 DATA 229,165,1,9,7,133,
      1,96,8,165,1
GM 320 DATA 41,248,133,1,162,0
      ,160,144,175
JB 330 DATA 0,0,176,208,191,6,
      232,240,3,76
HD 340 DATA 234,88,0,136,140,1
      39,10,232
BA 350 DATA 208,229,165,1,9,7,
      133,1,96,8
XB 360 DATA 165,1,41,248,133,1
      ,162,0,224
PP 370 DATA 144,239,0,0,240,20
      8,255,6,232
FA 380 DATA 240,3,76,218,89,0,
      200,140,203
EP 390 DATA 10,232,208,229,165
      ,1,9,7,133,1
SF 400 DATA 96,99
```

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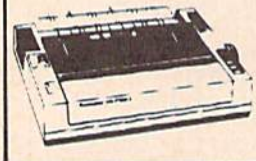

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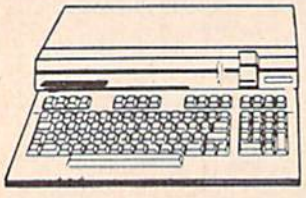

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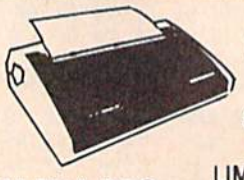

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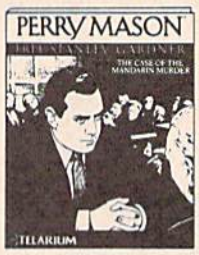

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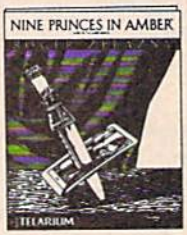

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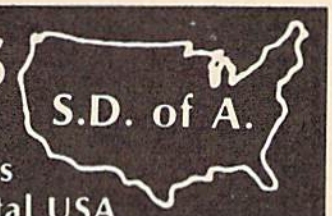

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How To Type In *COMPUTE!'s Gazette* Programs

Each month, COMPUTE!'s Gazette publishes programs for the Commodore 128, 64, Plus/4, and 16. Each program is clearly marked by title and version. Be sure to type in the correct version for your machine. All 64 programs run on the 128 in 64 mode. Be sure to read the instructions in the corresponding article. This can save time and eliminate any questions which might arise after you begin typing.

We frequently publish two programs designed to make typing easier: The Automatic Proofreader, and MLX, designed for entering machine language programs.

When entering a BASIC program, be especially careful with DATA statements as they are extremely sensitive to errors. A mistyped number in a DATA statement can cause your machine to "lock up" (you'll have no control over the computer). If this happens, the only recourse is to turn your computer off then on, erasing what was in memory. So be sure to *save a program before you run it.* If your computer crashes, you can always reload the program and look for the error.

Special Characters

Most of the programs listed in each issue contain special control characters. To facilitate typing in any programs from the GAZETTE, use the following listing conventions.

The most common type of control characters in our listings appear as words within braces: {DOWN} means to press the cursor down key; {5 SPACES} means to press the space bar five times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing another key), the character is underlined. For example, A means hold down the SHIFT key and press A. You may see strange characters on your screen, but that's to be expected. If you find a number followed by an underlined key enclosed in braces (for example, {8 A}), type the key as many times as indicated (in our example, enter eight SHIFTed A's).

If a key is enclosed in special brackets, [ ], hold down the Commodore key (at the lower left corner of the keyboard) and press the indicated character.

Rarely, you'll see a single letter of the alphabet enclosed in braces. This can be entered on the Commodore 64 by pressing the CTRL key while typing the letter in braces. For example, {A} means to press CTRL-A.

The Quote Mode

Although you can move the cursor around the screen with the CRSR keys, often a programmer will want to move the cursor under program control. This is seen in examples such as {LEFT}, and {HOME} in the program listings. The only way the computer can tell the difference between direct and programmed cursor control is *the quote mode.*

Once you press the quote key, you're in quote mode. This mode can be confusing if you mistype a character and cursor left to change it. You'll see a reverse video character (a graphics symbol for cursor left). In this case, you can use the DELete key to back up and edit the line. Type another quote and you're out of quote mode. If things really get confusing, you can exit quote mode simply by pressing RETURN. Then just cursor up to the mistyped line and fix it.

When You Read:	Press:	See:
{CLR}	SHIFT + CLR/HOME	
{HOME}	CLR/HOME	
{UP}	SHIFT + ↑ CRSR ↓	
{DOWN}	↑ CRSR ↓	
{LEFT}	SHIFT + ←CRSR→	
{RIGHT}	←CRSR→	
{RVS}	CTRL + 9	
{OFF}	CTRL + 0	
{BLK}	CTRL + 1	
{WHT}	CTRL + 2	
{RED}	CTRL + 3	
{CYN}	CTRL + 4	

When You Read:	Press:	See:
{PUR}	CTRL + 5	
{GRN}	CTRL + 6	
{BLU}	CTRL + 7	
{YEL}	CTRL + 8	
{ F1 }	f1	
{ F2 }	SHIFT + f1	
{ F3 }	f3	
{ F4 }	SHIFT + f3	
{ F5 }	f5	
{ F6 }	SHIFT + f5	
{ F7 }	f7	
{ F8 }	SHIFT + f7	

When You Read:	Press:	See:
←	←	
↑	SHIFT + ↑	

For Commodore 64 Only

[1]	COMMODORE + 1	
[2]	COMMODORE + 2	
[3]	COMMODORE + 3	
[4]	COMMODORE + 4	
[5]	COMMODORE + 5	
[6]	COMMODORE + 6	
[7]	COMMODORE + 7	
[8]	COMMODORE + 8	

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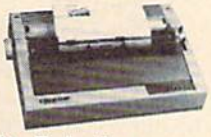

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MLX Machine Language Entry Program For Commodore 64 and 128

Ottis R. Cowper

"MLX" is a labor-saving utility that allows almost fail-safe entry of machine language programs. Included are versions for the Commodore 64 and 128.

Type in and save some copies of whichever version of MLX is appropriate for your computer (you'll want to use it to enter future ML programs from COMPUTE!'s GAZETTE). Program 1 is for the Commodore 64, and Program 2 is for the 128 (128 MLX can also be used to enter Commodore 64 ML programs for use in 64 mode). When you're ready to enter an ML program, load and run MLX. It asks you for a starting address and an ending address. These addresses appear in the article accompanying the MLX-format program listing you're typing.

If you're unfamiliar with machine language, the addresses (and all other values you enter in MLX) may appear strange. Instead of the usual decimal numbers you're accustomed to, these numbers are in *hexadecimal*—a base 16 numbering system commonly used by ML programmers. Hexadecimal—hex for short—includes the numerals 0–9 and the letters A–F. But don't worry—even if you know nothing about ML or hex, you should have no trouble using MLX.

After you enter the starting and ending addresses, you'll be offered the option of clearing the workspace. Choose this option if you're starting to enter a new listing. If you're continuing a listing that's partially typed from a previous session, don't choose this option.

A functions menu will appear. The first option in the menu is ENTER DATA. If you're just starting to type in a program, pick this. Press the E key, and type the first number in the first line of the program listing. If you've already typed in part of a program, type the line number where you left off typing at the end of the previous session (be sure to load the partially completed program before you resume entry). In any case, make sure the address you enter corresponds to the address of a line in the listing you are entering. Otherwise, you'll be unable to enter the data correctly. If you pressed E by mistake, you can return to the command menu by pressing RETURN alone when asked for the address. (You can get back to the menu from most options by pressing RETURN with no other input.)

Entering A Listing

Once you're in Enter mode, MLX prints the address for each program line for you. You then type in all nine numbers on that line, beginning with the first two-digit number after the colon (:). Each line represents eight data bytes and a checksum. Although an MLX-format listing appears similar to the "hex dump" listings from a machine language monitor program, the extra checksum number on the end allows MLX to check your typing. (Commodore 128 users *can* enter the data from an MLX listing using the built-in monitor if the rightmost column of data is omitted, but we recommend against it. It's much easier to let MLX do the proofreading and error checking for you.)

When you enter a line, MLX recalculates the checksum from the eight bytes and the address and compares this value to the number from the ninth column. If the values match, you'll hear a bell tone, the data will be added to the workspace area, and the prompt for the next line of data will appear. But if MLX detects a typing error, you'll hear a low buzz and see an error message. The line will then be redisplayed for editing.

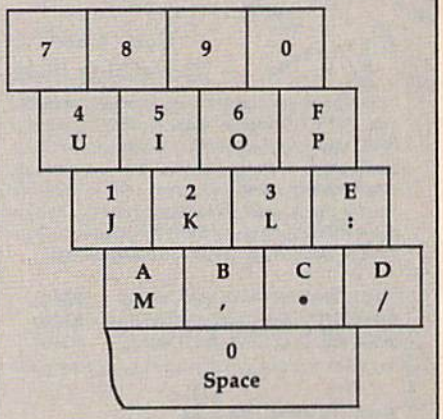
Invalid Characters Banned

Only a few keys are active while you're entering data, so you may have to unlearn some habits. You *do not* type spaces between the columns; MLX automatically inserts these for you. You *do not* press RETURN after typing the last number in a line; MLX automatically enters and checks the line after you type the last digit.

Only the numerals 0–9 and the letters A–F can be typed in. If you press any other key (with some exceptions noted below), you'll hear a warning buzz. To simplify typing, 128 MLX redefines the function keys and + and − keys on the numeric keypad so that you can enter data one-handed. (The 64 version incorporates the keypad modification from the March 1986 "Bug-Swatter" column, lines 485–487.) In either case, the keypad is active only while entering data. Addresses must be entered with the normal letter and number keys. The figures above show the keypad configurations for each version.

MLX checks for transposed characters. If you're supposed to type in A0 and instead enter 0A, MLX will catch your mistake. There is one error that can slip past MLX: Because of the checksum formula used, MLX won't notice if you accidentally type FF in place of 00, and vice versa. And there's a very slim chance that you could garble a line and still end up with a combination of characters that adds up to the proper checksum. However, these mistakes should not occur if you take reasonable care while entering data.

64 MLX Keypad



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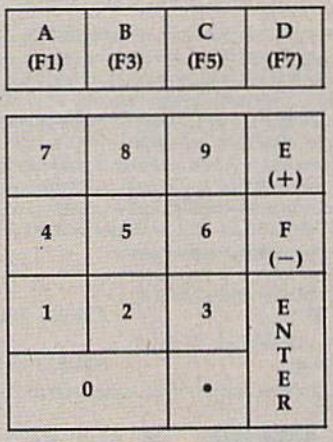

Editing Features

To correct typing mistakes before finishing a line, use the INST/DEL key to delete the character to the left of the cursor. (The cursor-left key also deletes.) If you mess up a line really badly, press CLR/HOME to start the line over. The RETURN key is also active, but only before any data is typed on a line. Pressing RETURN at this point returns you to the command menu. After you type a character of data, MLX disables RETURN until the cursor returns to the start of a line. Remember, you can press CLR/HOME to quickly get to a line

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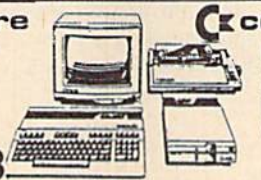

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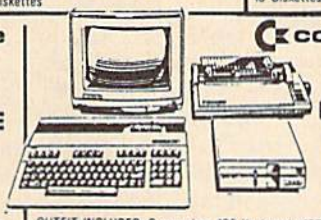

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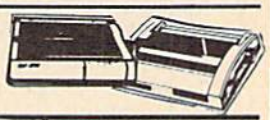

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number prompt.

More editing features are available when correcting lines in which MLX has detected an error. To make corrections in a line that MLX has redisplayed for editing, compare the line on the screen with the one printed in the listing, then move the cursor to the mistake and type the correct key. The cursor left and right keys provide the normal cursor controls. (The INST/DEL key now works as an alternative cursor-left key.) You cannot move left beyond the first character in the line. If you try to move beyond the rightmost character, you'll reenter the line. During editing, RETURN is active; pressing it tells MLX to recheck the line. You can press the CLR/HOME key to clear the entire line if you want to start from scratch, or if you want to get to a line number prompt to use RETURN to get back to the menu.

Display Data

The second menu choice, DISPLAY DATA, examines memory and shows the contents in the same format as the program listing (including the checksum). When you press D, MLX asks you for a starting address. Be sure that the starting address you give corresponds to a line number in the listing. Otherwise, the checksum display will be meaningless. MLX displays program lines until it reaches the end of the program, at which point the menu is redisplayed. You can pause the display by pressing the space bar. (MLX finishes printing the current line before halting.) Press space again to restart the display. To break out of the display and get back to the menu before the ending address is reached, press RETURN.

Other Menu Options

Two more menu selections let you save programs and load them back into the computer. These are SAVE FILE and LOAD FILE; their operation is quite straightforward. When you press S or L, MLX asks you for the filename. You'll then be asked to press either D or T to select disk or tape.

You'll notice the disk drive starting and stopping several times during a load or save (save only for the 128 version). Don't panic; this is normal behavior. MLX opens and reads from or writes to the file instead of using the usual LOAD and SAVE commands (128 MLX makes use of BLOAD). Disk users should also note that the drive prefix 0: is automatically added to the filename (line 750 in 64 MLX), so this should *not* be included when entering the name. This also precludes the use of @ for Save-with-Replace, so remember to give each version you save a different name. The 128 version makes up for this by giving you the option of scratching the existing file if you want to reuse a filename.

Remember that MLX saves the entire workspace area from the starting address to the ending address, so the save or load may take longer than you might expect if you've entered only a small amount of data from a long listing. When saving a partially completed listing, make sure to note the address where you stopped typing so you'll know where to resume entry when you reload.

MLX reports the standard disk or tape error messages if any problems are detected during the save or load. (Tape users should bear in mind that Commodore computers are never able to detect errors during a save to tape.) MLX also has three special load error messages: INCORRECT STARTING ADDRESS, which means the file you're trying to load does not have the starting address you specified when you ran MLX; LOAD ENDED AT *address*, which means the file you're trying to load ends before the ending address you specified when you started MLX; and TRUNCATED AT ENDING ADDRESS, which means the file you're trying to load extends beyond the ending address you specified when you started MLX. If you see one of these messages and feel certain that you've loaded the right file, exit and rerun MLX, being careful to enter the correct starting and ending addresses.

The 128 version also has a CATALOG DISK option so you can view the contents of the disk directory before saving or loading.

The QUIT menu option has the obvious effect—it stops MLX and enters BASIC. The RUN/STOP key is disabled, so the Q option lets you exit the program without turning off the computer. (Of course, RUN/STOP–RESTORE also gets you out.) You'll be asked for verification; press Y to exit to BASIC, or any other key to return to the menu. After quitting, you can type RUN again and reenter MLX without losing your data, as long as you don't use the clear workspace option.

The Finished Product

When you've finished typing all the data for an ML program and saved your work, you're ready to see the results. The instructions for loading and using the finished product vary from program to program. Some ML programs are designed to be loaded and run like BASIC programs, so all you need to type is LOAD *"filename"*,8 for disk (DLOAD *"filename"* on the 128) or LOAD *"filename"* for tape, and then RUN. Such programs will usually have a starting address of 0801 for the 64 or 1C01 for the 128. Other programs must be reloaded to specific addresses with a command such as LOAD *"filename"*,8,1 for disk (BLOAD *"filename"* on the 128) or LOAD *"filename"*,1,1 for tape, then started with a SYS to a particular memory address. On the Commodore 64, the most common starting address for such programs is 49152, which corresponds to MLX address C000. In either case, you should always refer to the article which accompanies the ML listing for information on loading and running the program.

An Ounce Of Prevention

By the time you finish typing in the data for a long ML program, you may have several hours invested in the project. Don't take chances—use our "Automatic Proofreader" to type the new MLX, and then test your copy *thoroughly* before first using it to enter any significant amount of data. Make sure all the menu options work as they should. Enter fragments of the program starting at several different addresses, then use the Display option to verify that the data has been entered correctly. And be sure to test the Save and Load options several times to ensure that you can recall your work from disk or tape. Don't let a simple typing error in the new MLX cost you several nights of hard work.

Program 1: MLX For Commodore 64

```
SS 10 REM VERSION 1.1: LINES 8
      30,950 MODIFIED, LINES 4
      85-487 ADDED
EK 100 POKE 56,50:CLR:DIM IN$,
      I,J,A,B,A$,B$,A(7),N$
DM 110 C4=48:C6=16:C7=7:Z2=2:Z
      4=254:Z5=255:Z6=256:Z7=
      127
CJ 120 FA=PEEK(45)+Z6*PEEK(46)
      :BS=PEEK(55)+Z6*PEEK(56
      ):H$="0123456789ABCDEF"
SB 130 R$=CHR$(13):L$="{LEFT}"
      :S$=" ":D$=CHR$(20):Z$=
      CHR$(0):T$="{13 RIGHT}"
CQ 140 SD=54272:FOR I=SD TO SD
      +23:POKE I,0:NEXT:POKE
      {SPACE}SD+24,15:POKE 78
      8,52
FC 150 PRINT"{CLR}"CHR$(142)CH
      R$(8):POKE 53280,15:POK
      E 53281,15
EJ 160 PRINT T$" {RED}{RVS}
      {2 SPACES}§8 @3
      {2 SPACES}"SPC(28)"
      {2 SPACES}{OFF}{BLU} ML
      X II {RED}{RVS}
      {2 SPACES}"SPC(28)"
      {12 SPACES}{BLU}"
FR 170 PRINT"{3 DOWN}
      {3 SPACES}COMPUTE!'S MA
      CHINE LANGUAGE EDITOR
      {3 DOWN}"
JB 180 PRINT"{BLK}STARTING ADD
```

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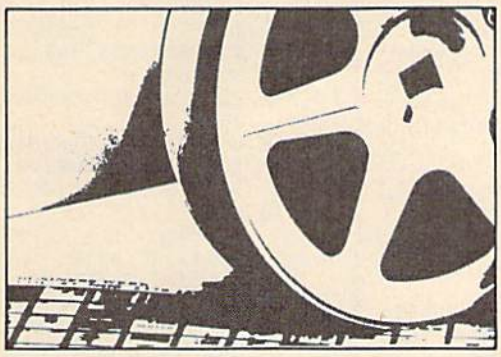

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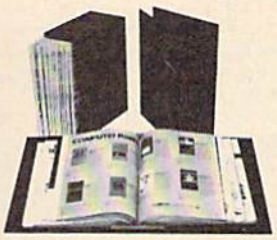

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```
      RESS[4]";:GOSUB300:SA=A
      D:GOSUB1040:IF F THEN18
      0
GF 190 PRINT"{BLK}{2 SPACES}EN
      DING ADDRESS[4]";:GOSUB
      300:EA=AD:GOSUB1030:IF
      {SPACE}F THEN190
KR 200 INPUT"{3 DOWN}{BLK}CLEA
      R WORKSPACE [Y/N][4]";A
      $:IF LEFT$(A$,1)<>"Y"TH
      EN220
PG 210 PRINT"{2 DOWN}{BLU}WORK
      ING...";:FORI=BS TO BS+
      EA-SA+7:POKE I,0:NEXT:P
      RINT"DONE"
DR 220 PRINTTAB(10)"{2 DOWN}
      {BLK}{RVS} MLX COMMAND
      {SPACE}MENU {DOWN}[4]":
      PRINT T$"{RVS}E{OFF}NTE
      R DATA"
BD 230 PRINT T$"{RVS}D{OFF}ISP
      LAY DATA":PRINT T$"
      {RVS}L{OFF}OAD FILE"
JS 240 PRINT T$"{RVS}S{OFF}AVE
       FILE":PRINT T$"{RVS}Q
      {OFF}UIT{2 DOWN}{BLK}"
JH 250 GET A$:IF A$=N$ THEN250
HK 260 A=0:FOR I=1 TO 5:IF A$=
      MID$("EDLSQ",I,1)THEN A
      =I:I=5
FD 270 NEXT:ON A GOTO420,610,6
      90,700,280:GOSUB1060:GO
      TO250
EJ 280 PRINT"{RVS} QUIT ":INPU
      T"{DOWN}[4]ARE YOU SURE
       [Y/N]";A$:IF LEFT$(A$,
      1)<>"Y"THEN220
EM 290 POKE SD+24,0:END
JX 300 IN$=N$:AD=0:INPUTIN$:IF
      LEN(IN$)<>4THENRETURN
KF 310 B$=IN$:GOSUB320:AD=A:B$
      =MID$(IN$,3):GOSUB320:A
      D=AD*256+A:RETURN
PP 320 A=0:FOR J=1 TO 2:A$=MID
      $(B$,J,1):B=ASC(A$)-C4+
      (A$>"@")*C7:A=A*C6+B
JA 330 IF B<0 OR B>15 THEN AD=
      0:A=-1:J=2
GX 340 NEXT:RETURN
CH 350 B=INT(A/C6):PRINT MID$(
      H$,B+1,1);:B=A-B*C6:PRI
      NT MID$(H$,B+1,1);:RETU
      RN
RR 360 A=INT(AD/Z6):GOSUB350:A
      =AD-A*Z6:GOSUB350:PRINT
      ":";
BE 370 CK=INT(AD/Z6):CK=AD-Z4*
      CK+Z5*(CK>Z7):GOTO390
PX 380 CK=CK*Z2+Z5*(CK>Z7)+A
JC 390 CK=CK+Z5*(CK>Z5):RETURN
QS 400 PRINT"{DOWN}STARTING AT
      [4]";:GOSUB300:IF IN$<>
      N$ THEN GOSUB1030:IF F
      {SPACE}THEN400
EX 410 RETURN
HD 420 PRINT"{RVS} ENTER DATA
      {SPACE}":GOSUB400:IF IN
      $=N$ THEN220
JK 430 OPEN3,3:PRINT
SK 440 POKE198,0:GOSUB360:IF F
       THEN PRINT IN$:PRINT"
      {UP}{5 RIGHT}";
GC 450 FOR I=0 TO 24 STEP 3:B$
      =S$:FOR J=1 TO 2:IF F T
      HEN B$=MID$(IN$,I+J,1)
HA 460 PRINT"{RVS}"B$L$;:IF I<
      24THEN PRINT"{OFF}";
HD 470 GET A$:IF A$=N$ THEN470
FK 480 IF(A$>"/"ANDA$<":")OR(A
      $>"@"ANDA$<"G")THEN540
GS 485 A=-(A$="M")-2*(A$=",")-
      3*(A$=".")-4*(A$="/")-5
      *(A$="J")-6*(A$="K")
FX 486 A=A-7*(A$="L")-8*(A$=:
      ")-9*(A$="U")-10*(A$="I
      ")-11*(A$="O")-12*(A$="
      P")
CM 487 A=A-13*(A$=S$):IF A THE
      N A$=MID$("ABCD123E456F
      0",A,1):GOTO 540
MP 490 IF A$=R$ AND((I=0)AND(J
      =1)OR F)THEN PRINT B$;:
      J=2:NEXT:I=24:GOTO550
KC 500 IF A$="{HOME}" THEN PRI
      NT B$:J=2:NEXT:I=24:NEX
      T:F=0:GOTO440
MX 510 IF(A$="{RIGHT}")ANDF TH
      ENPRINT B$L$;:GOTO540
GK 520 IF A$<>L$ AND A$<>D$ OR
      ((I=0)AND(J=1))THEN GOS
      UB1060:GOTO470
HG 530 A$=L$+S$+L$:PRINT B$L$;
      :J=2-J:IF J THEN PRINT
      {SPACE}L$;:I=I-3
QS 540 PRINT A$;:NEXT J:PRINT
      {SPACE}S$;
PM 550 NEXT I:PRINT:PRINT"{UP}
      {5 RIGHT}";:INPUT#3,IN$
      :IF IN$=N$ THEN CLOSE3:
      GOTO220
QC 560 FOR I=1 TO 25 STEP3:B$=
      MID$(IN$,I):GOSUB320:IF
       I<25 THEN GOSUB380:A(I
      /3)=A
PK 570 NEXT:IF A<>CK THEN GOSU
      B1060:PRINT"{BLK}{RVS}
      {SPACE}ERROR: REENTER L
      INE [4]":F=1:GOTO440
HJ 580 GOSUB1080:B=BS+AD-SA:FO
      R I=0 TO 7:POKE B+I,A(I
      ):NEXT
QQ 590 AD=AD+8:IF AD>EA THEN C
      LOSE3:PRINT"{DOWN}{BLU}
      ** END OF ENTRY **{BLK}
      {2 DOWN}":GOTO700
GQ 600 F=0:GOTO440
QA 610 PRINT"{CLR}{DOWN}{RVS}
      {SPACE}DISPLAY DATA ":G
      OSUB400:IF IN$=N$ THEN2
      20
RJ 620 PRINT"{DOWN}{BLU}PRESS:
       {RVS}SPACE{OFF} TO PAU
      SE, {RVS}RETURN{OFF} TO
       BREAK[4]{DOWN}"
KS 630 GOSUB360:B=BS+AD-SA:FOR
      I=BTO B+7:A=PEEK(I):GOS
      UB350:GOSUB380:PRINT S$
      ;
CC 640 NEXT:PRINT"{RVS}";:A=CK
      :GOSUB350:PRINT
KH 650 F=1:AD=AD+8:IF AD>EA TH
      ENPRINT"{DOWN}{BLU}** E
      ND OF DATA **":GOTO220
KC 660 GET A$:IF A$=R$ THEN GO
      SUB1080:GOTO220
EQ 670 IF A$=S$ THEN F=F+1:GOS
      UB1080
AD 680 ONFGOTO630,660,630
CM 690 PRINT"{DOWN}{RVS} LOAD
      {SPACE}DATA ":OP=1:GOTO
      710
PC 700 PRINT"{DOWN}{RVS} SAVE
      {SPACE}FILE ":OP=0
RX 710 IN$=N$:INPUT"{DOWN}FILE
      NAME[4]";IN$:IF IN$=N$
      {SPACE}THEN220
PR 720 F=0:PRINT"{DOWN}{BLK}
      {RVS}T{OFF}APE OR {RVS}
      D{OFF}ISK: [4]";
FP 730 GET A$:IF A$="T"THEN PR
      INT"T[DOWN]":GOTO880
HQ 740 IF A$<>"D"THEN730
HH 750 PRINT"D[DOWN]":OPEN15,8
      ,15,"I0:":B=EA-SA:IN$="
      0:"+IN$:IF OP THEN810
SQ 760 OPEN 1,8,8,IN$+",P,W":G
      OSUB860:IF A THEN220
FJ 770 AH=INT(SA/256):AL=SA-(A
      H*256):PRINT#1,CHR$(AL)
      ;CHR$(AH);
PE 780 FOR I=0 TO B:PRINT#1,CH
      R$(PEEK(BS+I));:IF ST T
      HEN800
FC 790 NEXT:CLOSE1:CLOSE15:GOT
      O940
GS 800 GOSUB1060:PRINT"{DOWN}
      {BLK}ERROR DURING SAVE:
      [4]":GOSUB860:GOTO220
MA 810 OPEN 1,8,8,IN$+",P,R":G
      OSUB860:IF A THEN220
GE 820 GET#1,A$,B$:AD=ASC(A$+Z
      $)+256*ASC(B$+Z$):IF AD
      <>SA THEN F=1:GOTO850
RX 830 FOR I=0 TO B:GET#1,A$:P
      OKE BS+I,ASC(A$+Z$):IF(
      I<>B)AND ST THEN F=2:AD
      =I:I=B
FA 840 NEXT:IF ST<>64 THEN F=3
FQ 850 CLOSE1:CLOSE15:ON ABS(F
      >0)+1 GOTO960,970
SA 860 INPUT#15,A,A$:IF A THEN
       CLOSE1:CLOSE15:GOSUB10
      60:PRINT"{RVS}ERROR: "A
      $
GQ 870 RETURN
EJ 880 POKE183,PEEK(FA+2):POKE
      187,PEEK(FA+3):POKE188,
      PEEK(FA+4):IFOP=0THEN92
      0
HJ 890 SYS 63466:IF(PEEK(783)A
      ND1)THEN GOSUB1060:PRIN
      T"{DOWN}{RVS} FILE NOT
      {SPACE}FOUND ":GOTO690
CS 900 AD=PEEK(829)+256*PEEK(8
      30):IF AD<>SA THEN F=1:
      GOTO970
SC 910 A=PEEK(831)+256*PEEK(83
      2)-1:F=F-2*(A<EA)-3*(A>
      EA):AD=A-AD:GOTO930
KM 920 A=SA:B=EA+1:GOSUB1010:P
      OKE780,3:SYS 63338
JF 930 A=BS:B=BS+(EA-SA)+1:GOS
      UB1010:ON OP GOTO950:SY
      S 63591
AE 940 GOSUB1080:PRINT"{BLU}**
       SAVE COMPLETED **":GOT
      O220
XP 950 POKE147,0:SYS 63562:IF
      {SPACE}ST>0 THEN970
FR 960 GOSUB1080:PRINT"{BLU}**
       LOAD COMPLETED **":GOT
      O220
DP 970 GOSUB1060:PRINT"{BLK}
      {RVS}ERROR DURING LOAD:
      {DOWN}[4]":ON F GOSUB98
      0,990,1000:GOTO220
PP 980 PRINT"INCORRECT STARTIN
      G ADDRESS (";:GOSUB360:
      PRINT")":RETURN
GR 990 PRINT"LOAD ENDED AT ";:
      AD=SA+AD:GOSUB360:PRINT
       D$:RETURN
FD 1000 PRINT"TRUNCATED AT END
      ING ADDRESS":RETURN
RX 1010 AH=INT(A/256):AL=A-(AH
      *256):POKE193,AL:POKE1
      94,AH
FF 1020 AH=INT(B/256):AL=B-(AH
      *256):POKE174,AL:POKE1
      75,AH:RETURN
FX 1030 IF AD<SA OR AD>EA THEN
       1050
HA 1040 IF(AD>511 AND AD<40960
```

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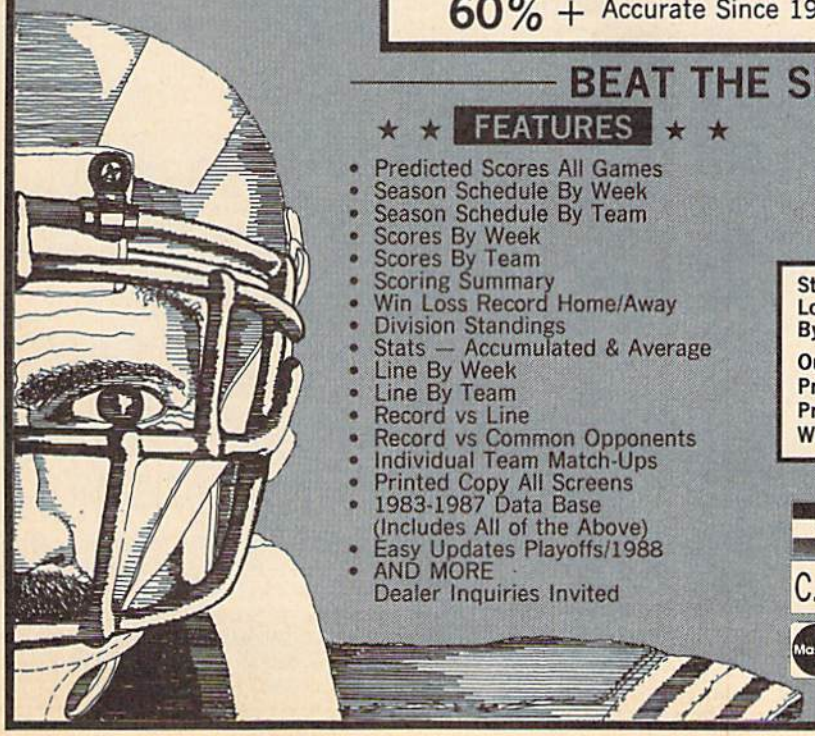

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```
        )OR(AD>49151 AND AD<53
        248)THEN GOSUB1080:F=0
        :RETURN
HC 1050 GOSUB1060:PRINT"{RVS}
        {SPACE}INVALID ADDRESS
         {DOWN}{BLK}":F=1:RETU
        RN
AR 1060 POKE SD+5,31:POKE SD+6
        ,208:POKE SD,240:POKE
        {SPACE}SD+1,4:POKE SD+
        4,33
DX 1070 FOR S=1 TO 100:NEXT:GO
        TO1090
PF 1080 POKE SD+5,8:POKE SD+6,
        240:POKE SD,0:POKE SD+
        1,90:POKE SD+4,17
AC 1090 FOR S=1 TO 100:NEXT:PO
        KE SD+4,0:POKE SD,0:PO
        KE SD+1,0:RETURN
```

Program 2: MLX For Commodore 128

```
AE 100 TRAP 960:POKE 4627,128:
       DIM NL$,A(7)
XP 110 Z2=2:Z4=254:Z5=255:Z6=2
       56:Z7=127:BS=256*PEEK(4
       627):EA=65280
FB 120 BE$=CHR$(7):RT$=CHR$(13
       ):DL$=CHR$(20):SP$=CHR$
       (32):LF$=CHR$(157)
KE 130 DEF FNHB(A)=INT(A/256):
       DEF FNLB(A)=A-FNHB(A)*2
       56:DEF FNAD(A)=PEEK(A)+
       256*PEEK(A+1)
JB 140 KEY 1,"A":KEY 3,"B":KEY
        5,"C":KEY 7,"D":VOL 15
       :IF RGR(0)=5 THEN FAST
FJ 150 PRINT"{CLR}"CHR$(142);C
       HR$(8):COLOR 0,15:COLOR
        4,15:COLOR 6,15
GQ 160 PRINT TAB(12)"{RED}
       {RVS}{2 SPACES}{9 @}
       {2 SPACES}"RT$;TAB(12)"
       {RVS}{2 SPACES}{OFF}
       {BLU} 128 MLX {RED}
       {RVS}{2 SPACES}"RT$;TAB
       (12)"{RVS}{13 SPACES}
       {BLU}"
FE 170 PRINT"{2 DOWN}
       {3 SPACES}COMPUTE!'S MA
       CHINE LANGUAGE EDITOR
       {2 DOWN}"
DK 180 PRINT"{BLK}STARTING ADD
       RESS{4}";:GOSUB 260:IF
       {SPACE}AD THEN SA=AD:EL
       SE 180
FH 190 PRINT"{BLK}{2 SPACES}EN
       DING ADDRESS{4}";:GOSUB
        260:IF AD THEN EA=AD:E
       LSE 190
MF 200 PRINT"{DOWN}{BLK}CLEAR
       {SPACE}WORKSPACE [Y/N]?
       {4}":GETKEY A$:IF A$<>"
       Y" THEN 220
QH 210 PRINT"{DOWN}{BLU}WORKIN
       G...";:BANK 0:FOR A=BS
       {SPACE}TO BS+(EA-SA)+7:
       POKE A,0:NEXT A:PRINT"D
       ONE"
DC 220 PRINT TAB(10)"{DOWN}
       {BLK}{RVS} MLX COMMAND
       {SPACE}MENU {4}{DOWN}":
       PRINT TAB(13)"{RVS}E
       {OFF}NTER DATA"RT$;TAB(
       13)"{RVS}D{OFF}ISPLAY D
       ATA"RT$;TAB(13)"{RVS}L
       {OFF}OAD FILE"
HB 230 PRINT TAB(13)"{RVS}S
       {OFF}AVE FILE"RT$;TAB(1
       3)"{RVS}C{OFF}ATALOG DI
       SK"RT$;TAB(13)"{RVS}Q
       {OFF}UIT{DOWN}{BLK}"
AP 240 GETKEY A$:A=INSTR("EDLS
       CQ",A$):ON A GOTO 340,5
       50,640,650,930,940:GOSU
       B 950:GOTO 240
SX 250 PRINT"STARTING AT";:GOS
       UB 260:IF(AD<>0)OR(A$=N
       L$)THEN RETURN:ELSE 250
BG 260 A$=NL$:INPUT A$:IF LEN(
       A$)=4 THEN AD=DEC(A$)
PP 270 IF AD=0 THEN BEGIN:IF A
       $<>NL$ THEN 300:ELSE RE
       TURN:BEND
MA 280 IF AD<SA OR AD>EA THEN
       {SPACE}300
PM 290 IF AD>511 AND AD<65280
       {SPACE}THEN PRINT BE$;:
       RETURN
SQ 300 GOSUB 950:PRINT"{RVS} I
       NVALID ADDRESS {DOWN}
       {BLK}":AD=0:RETURN
RD 310 CK=FNHB(AD):CK=AD-Z4*CK
       +Z5*(CK>Z7):GOTO 330
DD 320 CK=CK*Z2+Z5*(CK>Z7)+A
AH 330 CK=CK+Z5*(CK>Z5):RETURN
QD 340 PRINT BE$;"{RVS} ENTER
       {SPACE}DATA ":GOSUB 250
       :IF A$=NL$ THEN 220
JA 350 BANK 0:PRINT:F=0:OPEN 3
       ,3
BR 360 GOSUB 310:PRINT HEX$(AD
       )+":";:IF F THEN PRINT
       {SPACE}L$:PRINT"{UP}
       {5 RIGHT}";
QA 370 FOR I=0 TO 24 STEP 3:B$
       =SP$:FOR J=1 TO 2:IF F
       {SPACE}THEN B$=MID$(L$,
       I+J,1)
PS 380 PRINT"{RVS}"B$+LF$;:IF
       {SPACE}I<24 THEN PRINT"
       {OFF}";
RC 390 GETKEY A$:IF (A$>"/" AN
       D A$<":") OR(A$>"@" AND
        A$<"G") THEN 470
AC 400 IF A$="+" THEN A$="E":G
       OTO 470
QB 410 IF A$="-" THEN A$="F":G
       OTO 470
FB 420 IF A$=RT$ AND ((I=0) AN
       D (J=1) OR F) THEN PRIN
       T B$;:J=2:NEXT:I=24:GOT
       O 480
RD 430 IF A$="{HOME}" THEN PRI
       NT B$:J=2:NEXT:I=24:NEX
       T:F=0:GOTO 360
XB 440 IF (A$="{RIGHT}") AND F
        THEN PRINT B$+LF$;:GOT
       O 470
JP 450 IF A$<>LF$ AND A$<>DL$
       {SPACE}OR ((I=0) AND (J
       =1)) THEN GOSUB 950:GOT
       O 390
PS 460 A$=LF$+SP$+LF$:PRINT B$
       +LF$;:J=2-J:IF J THEN P
       RINT LF$;:I=I-3
GB 470 PRINT A$;:NEXT J:PRINT
       {SPACE}SP$;
HA 480 NEXT I:PRINT:PRINT"{UP}
       {5 RIGHT}";:L$="
       {27 SPACES}"
DP 490 FOR I=1 TO 25 STEP 3:GE
       T#3,A$,B$:IF A$=SP$ THE
       N I=25:NEXT:CLOSE 3:GOT
       O 220
BA 500 A$=A$+B$:A=DEC(A$):MID$
       (L$,I,2)=A$:IF I<25 THE
       N GOSUB 320:A(I/3)=A:GE
       T#3,A$
AR 510 NEXT I:IF A<>CK THEN GO
       SUB 950:PRINT:PRINT"
       {RVS} ERROR: REENTER LI
       NE ":F=1:GOTO 360
DX 520 PRINT BE$:B=BS+AD-SA:FO
       R I=0 TO 7:POKE B+I,A(I
       ):NEXT I
XB 530 F=0:AD=AD+8:IF AD<=EA T
       HEN 360
CA 540 CLOSE 3:PRINT"{DOWN}
       {BLU}** END OF ENTRY **
       {BLK}{2 DOWN}":GOTO 650
MC 550 PRINT BE$;"{CLR}{DOWN}
       {RVS} DISPLAY DATA ":GO
       SUB 250:IF A$=NL$ THEN
       {SPACE}220
JF 560 BANK 0:PRINT"{DOWN}
       {BLU}PRESS: {RVS}SPACE
       {OFF} TO PAUSE, {RVS}RE
       TURN{OFF} TO BREAK{4}
       {DOWN}"
XA 570 PRINT HEX$(AD)+":";:GOS
       UB 310:B=BS+AD-SA
DJ 580 FOR I=B TO B+7:A=PEEK(I
       ):PRINT RIGHT$(HEX$(A),
       2);SP$;:GOSUB 320:NEXT
       {SPACE}I
XB 590 PRINT"{RVS}";RIGHT$(HEX
       $(CK),2)
GR 600 F=1:AD=AD+8:IF AD>EA TH
       EN PRINT"{BLU}** END OF
        DATA **":GOTO 220
EB 610 GET A$:IF A$=RT$ THEN P
       RINT BE$:GOTO 220
QK 620 IF A$=SP$ THEN F=F+1:PR
       INT BE$;
XS 630 ON F GOTO 570,610,570
RF 640 PRINT BE$"{DOWN}{RVS} L
       OAD DATA ":OP=1:GOTO 66
       0
BP 650 PRINT BE$"{DOWN}{RVS} S
       AVE FILE ":OP=0
DM 660 F=0:F$=NL$:INPUT"FILENA
       ME{4}";F$:IF F$=NL$ THE
       N 220
PF 665 IF LEN(F$)>14 THEN 660
RF 670 PRINT"{DOWN}{BLK}{RVS}T
       {OFF}APE OR {RVS}D{OFF}
       ISK: {4}";
SQ 680 GETKEY A$:IF A$="T" THE
       N 850:ELSE IF A$<>"D" T
       HEN 680
SP 690 PRINT"DISK{DOWN}":IF OP
        THEN 760
EH 700 DOPEN#1,(F$+",P"),W:IF
       {SPACE}DS THEN A$=D$:GO
       TO 740
JH 710 BANK 0:POKE BS-2,FNLB(S
       A):POKE BS-1,FNHB(SA):P
       RINT"SAVING ";F$:PRINT
MC 720 FOR A=BS-2 TO BS+EA-SA:
       PRINT#1,CHR$(PEEK(A));:
       IF ST THEN A$="DISK WRI
       TE ERROR":GOTO 750
GC 730 NEXT A:CLOSE 1:PRINT"
       {BLU}** SAVE COMPLETED
       {SPACE}WITHOUT ERRORS *
       *":GOTO 220
RA 740 IF DS=63 THEN BEGIN:CLO
       SE 1:INPUT"{BLK}REPLACE
        EXISTING FILE [Y/N]{4}
       ";A$:IF A$="Y" THEN SCR
       ATCH(F$):PRINT:GOTO 700
       :ELSE PRINT"{BLK}":GOTO
        660:BEND
GA 750 CLOSE 1:GOSUB 950:PRINT
       "{BLK}{RVS} ERROR DURIN
       G SAVE: {4}":PRINT A$:G
       OTO 220
FD 760 DOPEN#1,(F$+",P"):IF DS
        THEN A$=DS$:F=4:CLOSE
       {SPACE}1:GOTO 790
```

```
PX 770 GET#1,A$,B$:CLOSE 1:AD=
       ASC(A$)+256*ASC(B$):IF
       {SPACE}AD<>SA THEN F=1:
       GOTO 790
KB 780 PRINT"LOADING ";F$:PRIN
       T:BLOAD(F$),B0,P(BS):AD
       =SA+FNAD(174)-BS-1:F=-2
       *(AD<EA)-3*(AD>EA)
RQ 790 IF F THEN 800:ELSE PRIN
       T"{BLU}** LOAD COMPLETE
       D WITHOUT ERRORS **":GO
       TO 220
ER 800 GOSUB 950:PRINT"{BLK}
       {RVS} ERROR DURING LOAD
       : {4}":ON F GOSUB 810,8
       20,830,840:GOTO220
QJ 810 PRINT"INCORRECT STARTIN
       G ADDRESS (";HEX$(AD);"
       )":RETURN
DP 820 PRINT"LOAD ENDED AT ";H
       EX$(AD):RETURN
EB 830 PRINT"TRUNCATED AT ENDI
       NG ADDRESS ("HEX$(EA)")
       ":RETURN
FP 840 PRINT"DISK ERROR ";A$:R
       ETURN
KS 850 PRINT"TAPE":AD=POINTER(
       F$):BANK 1:A=PEEK(AD):A
       L=PEEK(AD+1):AH=PEEK(AD
       +2)
XX 860 BANK 15:SYS DEC("FF68")
       ,0,1:SYS DEC("FFBA"),1,
       1,0:SYS DEC("FFBD"),A,A
       L,AH:SYS DEC("FF90"),12
       8:IF OP THEN 890
FG 870 PRINT:A=SA:B=EA+1:GOSUB
        920:SYS DEC("E919"),3:
       PRINT"SAVING ";F$
AB 880 A=BS:B=BS+(EA-SA)+1:GOS
       UB 920:SYS DEC("EA18"):
       PRINT"{DOWN}{BLU}** TAP
       E SAVE COMPLETED **":GO
       TO 220
CP 890 SYS DEC("E99A"):PRINT:I
       F PEEK(2816)=5 THEN GOS
       UB 950:PRINT"{DOWN}
       {BLK}{RVS} FILE NOT FOU
       ND ":GOTO 220
GQ 900 PRINT"LOADING ...{DOWN}
       ":AD=FNAD(2817):IF AD<>
       SA THEN F=1:GOTO 800:EL
       SE AD=FNAD(2819)-1:F=-2
       *(AD<EA)-3*(AD>EA)
JD 910 A=BS:B=BS+(EA-SA)+1:GOS
       UB 920:SYS DEC("E9FB"):
       IF ST>0 THEN 800:ELSE 7
       90
XB 920 POKE193,FNLB(A):POKE194
       ,FNHB(A):POKE 174,FNLB(
       B):POKE 175,FNHB(B):RET
       URN
CP 930 CATALOG:PRINT"{DOWN}
       {BLU}** PRESS ANY KEY F
       OR MENU **":GETKEY A$:G
       OTO 220
MM 940 PRINT BE$"{RVS} QUIT
       {4}";RT$;"ARE YOU SURE
       {SPACE}{Y/N}?":GETKEY A
       $:IF A$<>"Y" THEN 220:E
       LSE PRINT"{CLR}":BANK 1
       5:END
JE 950 SOUND 1,500,10:RETURN
AF 960 IF ER=14 AND EL=260 THE
       N RESUME 300
MK 970 IF ER=14 AND EL=500 THE
       N RESUME NEXT
KJ 980 IF ER=4 AND EL=780 THEN
        F=4:A$=DS$:RESUME 800
DQ 990 IF ER=30 THEN RESUME:EL
       SE PRINT ERR$(ER);" ERR
       OR IN LINE";EL
```


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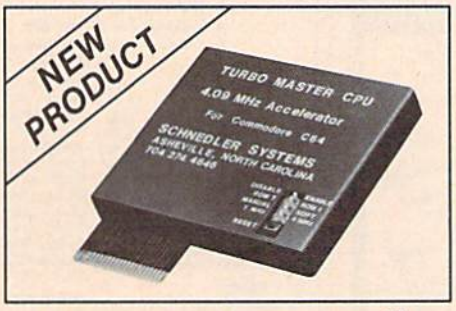

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Official Rules

1. Employees of Berkeley Softworks, Quantum Computer Services, Laser Direct, Compute!'s Gazette Magazine, their advertising and promotional agencies and their immediate families are not eligible to enter the contest.

2. Each entry must be your original work, previously unpublished in any form. All those programs accepted will be required to affirm this in writing.

3. Contestants may enter multiple categories, but may only submit one entry per category per division (e.g. one entry in the Entertainment category Applications Division, *and* one entry in the Entertainment Desk Accessories Division). Regardless of the number of categories you enter, you will only be eligible to win one prize.

4. Deadline for entries is August 31, 1988. Mail entries to Compute!'s Gazette, P.O. Box 5406, Greensboro, NC, 27403
Attn: GEOS Programming Contest.

5. Acceptance of an entry shall not create any implication that the entry has been received and reviewed by Berkeley Softworks or has been used in any way in product development.

6. Judging will be performed by the staff of Compute!'s Gazette Magazine. The decisions of the judges are final in all respects. This includes decisions regarding creativity, similarity among entries and general suitability.

7. Entries become the property of Berkeley Softworks, which reserves the right to adapt, use or publish all entries received. Entries may become part of a "shareware" library to be distributed by Berkeley Softworks, Compute!'s Gazette and Quantum Computer Services. As part of each submission, contestants should include *in* the program their name, address and a "user fee" amount for satisfied users to send a discretionary payment.

8. Entries may be written in any programming language but must be a GEOS based program supporting the GEOS file structure and be executable from the GEOS deskTop or a GEOS application. Whichever language is chosen, the code must be a self-standing program that can be run by someone who does not own the language. We must be able to legally distribute the program without incurring licensing fees or any other obligations to the maker of the language.

9. Entries must be submitted on 5.25" floppy disks in 1541/1571 format. The following should be clearly marked on both the printout and the disk:
A. Contestant's name, address and phone number.
B. Category and division for the entry.
C. Intended use for the program.

10. Entries must be accompanied by a description which explains how to use the program and what it does.

11. This contest is void where prohibited by law. All federal, state and local taxes are the sole responsibility of the winners.

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- Entries will be judged on creativity, originality, interface consistency with other GEOS programs and error-free quality of the code.
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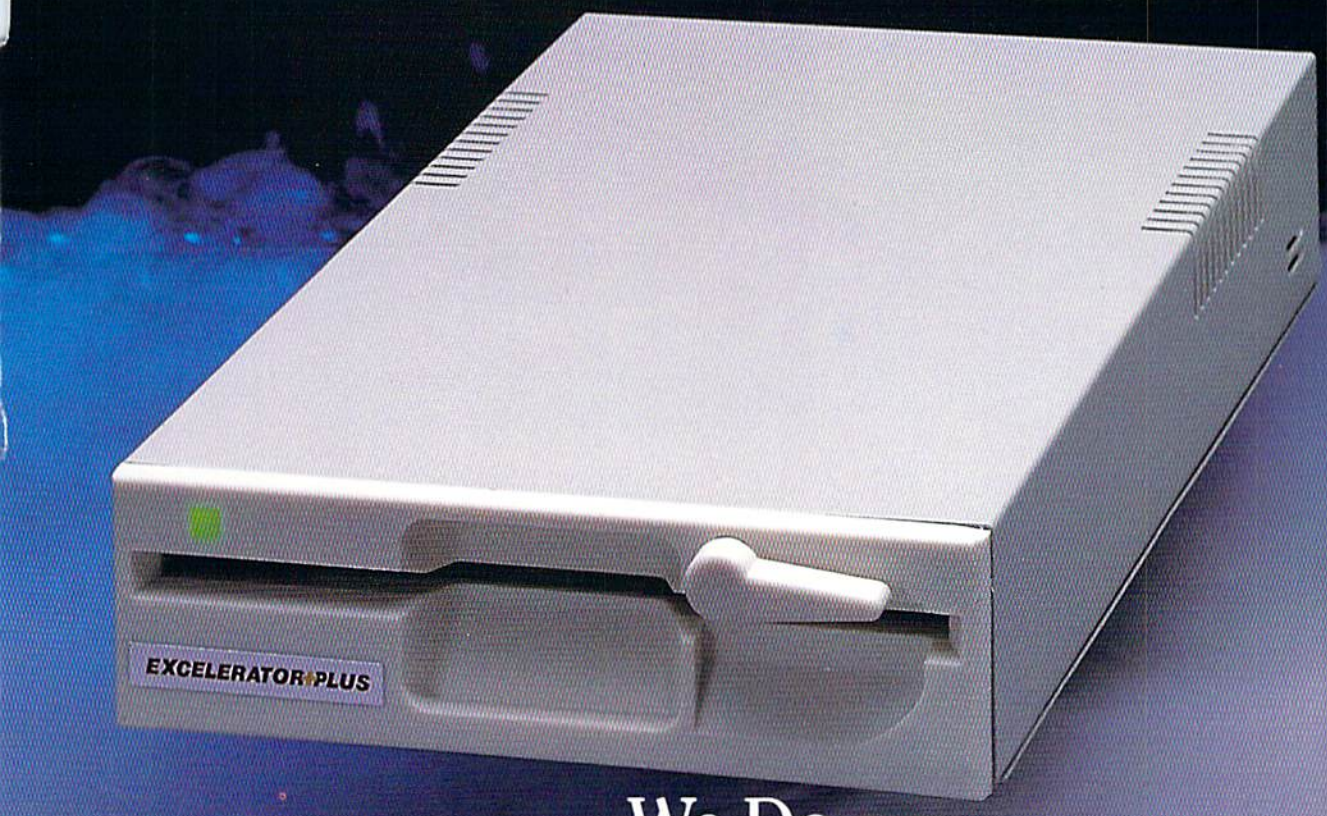

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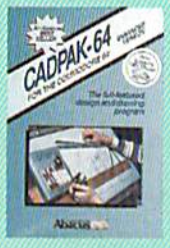

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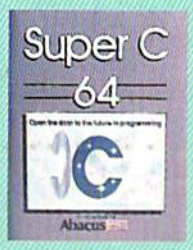

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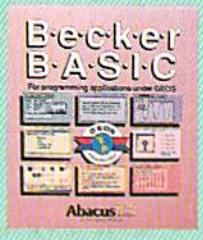

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